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Striped Marsh Frog (*Limnodynastes peronii*) from Coffs Harbour, New South Wales (Photo: M. Murphy). See paper on the herpetofauna of the Coffs Harbour urban bushland on p. 17.

Male combat in Carpet Pythons (*Morelia spilota variegata*) on Melville Island, Northern Territory. (Photo: D. Rhind). See paper on this observation on p. 66.

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Herpetofauna Volume 41 (combined issue of parts 1 and 2) was issued in June 2013.
Volume 42 (for 2012) will similarly be a single combined issue.

A SECOND MAINLAND POPULATION OF *CTENOTUS ANGUSTICEPS* (LACERTILIA: SCINCIDAE) FROM PORT HEDLAND, WESTERN AUSTRALIA, WITH NOTES ON HABITAT

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INTRODUCTION

Ctenotus angusticeps is a small, slender, faintly-patterned skink with a longitudinal series of white and grey, dark-edged spots along the flanks and back (Storr *et al.*, 1999). Along with *C. pantherinus*, *C. angusticeps* forms the only other member of the *pantherinus* group (Storr *et al.*, 1999), a species group whose pattern consists entirely or almost entirely of black-and-white ocelli.

Unlike the common and widespread *C. pantherinus*, *C. angusticeps* appears to have a highly restricted range and until now was known from only two widely separated locations along the north-western Australian coastline (Figure 1): Airlie Island, a small (0.28 km^2) island 35 km north-east of Onslow (Storr, 1988, Browne-Cooper & Maryan, 1990) and Roebuck Bay (Thangoo Station), south of Broome (Sadlier, 1993). The Airlie Island and Roebuck Bay populations are separated by approximately 800 km.

On Airlie Island, *C. angusticeps* occurs in a wide variety of vegetation types including low open *Acacia coriacea* shrubland and coastal spinifex in the littoral zone, but appears to prefer tussock grassland on the western end of the island (Browne-Cooper & Maryan, 1990). At Roebuck Bay, it inhabits a small area of samphire shrubland along a mangrove margin (Sadlier, 1993).

As a result of its limited distribution, *Ctenotus angusticeps* is listed under both state and federal legislation. It is listed as vulnerable under the Environment Protection and Biodiversity Act 1999 (federal) and the Wildlife Conservation Act 1950 (Western Australia).

Here we describe the discovery of a new population of *C. angusticeps* at Port Hedland, Western Australia, with notes on the habitat where it was found and comparisons with superficially similar *C. saxatilis*.

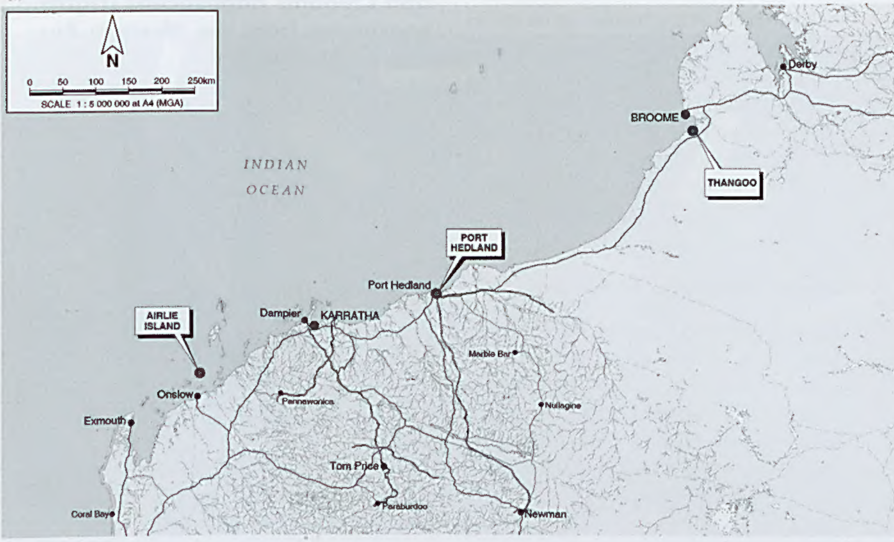
METHODS

During November 2010 we visited an area of mangroves, mudflats and adjacent samphire shrubland south of Port Hedland. Over three consecutive afternoons (3-5.xi.2010) we observed several skinks active in the low vegetation adjacent to the mangroves that superficially resembled *C. angusticeps*.

Table 1. Records of *Ctenotus angusticeps* from Port Hedland.

Date	Individuals Recorded	Time (Australian Western Standard Time)	Temperature and Comments
3.xi.2010	2	1820	28.8°C, specimen collected
4.xi.2010	2	1735	29.9°C
5.xi.2010	1	1555	31.8°C

Figure 1. Known distribution of *Ctenotus angusticeps*.



A single specimen was collected for the Western Australian Museum (R170418) and later compared with specimens from Roebuck Bay (R108260, R108261) and Airlie Island (R104349, R103931, R102067). The three paratypes (R96987-89) and the holotype of *C. angusticeps* (R97423) were also examined.

RESULTS

Ctenotus angusticeps was recorded from Redbank, 6 km south of Port Hedland representing a range extension of approximately 370 km from Airlie Island and over 470 km from the Roebuck Bay population. All *C. angusticeps* were observed in the late afternoon during warm temperatures (Table 1). A total of five individuals was recorded from three locations along 500 m of contiguous vegetation.

Voucher specimen

A brief description of the individual vouchered with the Western Australian Museum is presented below (Figure 2).

Size. The overall size of the specimen was small, with a snout-vent length (SVL) of 44 mm. The distal tip of the tail was lost during capture and so a total length was not obtained. The head was observed to be narrow (6.5 mm at widest point) tapering to the nasals (width of 2.1mm), the trait referred to in the scientific name.

Scalation. Nasal scales in narrow contact, prefrontals in broad contact. Supraoculars 4 (the second twice as wide as the third), supracillaries 7 (the first three much larger than fourth to sixth). Upper labials 7, ear lobules 3, nuchals 3. Midbody scales in 28 rows. Lamellae under longest toe 18 with a narrow callus; plantar scales rounded.

Figure 2. *Ctenotus angusticeps* recorded from Port Hedland.

Pattern. Back and sides grey-brown, sides mottled with a series of broken stripes. A distinct black vertebral stripe breaks up on tail to become a series of irregular dashes. The vertebral stripe is flanked by a broad, pale brown paravertebral stripe. Dark laterodorsal stripes are punctuated by a series of brown blotches. The upper lateral, mid lateral and laterodorsal zones contain a series of dark-edged ocelli, forming an indistinct series of longitudinal lines.

Comparison with other specimens

The Western Australian Museum holds eleven specimens of *Ctenotus angusticeps*: eight from Airlie Island, two from Roebuck Bay and the one described here from Port Hedland. The published description of *Ctenotus angusticeps* is based on individuals collected from Airlie Island (Storr, 1988).

Scale characters of the specimen we collected from Port Hedland are mostly equivalent to published descriptions of *C. angusticeps* (Storr, 1988; Storr *et al.*, 1999), except for the prefrontals, which are described as narrowly separated. Two of the eight *C. angusticeps* from Airlie Island have prefrontals in narrow contact, suggesting that separation of the prefrontals is not always consistent in *C. angusticeps*.

In comparison to the Airlie Island and Roebuck Bay specimens, the specimen we collected is more boldly patterned, with distinct striping, particularly a dark vertebral stripe. Juvenile patterning is not well described in *Ctenotus* but tends to be simpler and bolder, becoming more complex and faded with age. This appears to be the case in *Ctenotus angusticeps* and may lead to confusion with *Ctenotus saxatilis* of similar size. However, juvenile *C. saxatilis* have a rounder snout when viewed from above and a pattern including unbroken lines, particularly well-defined pale dorsolateral stripes and pale paravertebral stripes (Figure 3).

The 'beaked' appearance of the snout from above (narrow, tapering to nasals) was consistent across all specimens, including from

Figure 3. *Ctenotus saxatilis* (left) and *Ctenotus angusticeps* (right) specimens from the Western Australian Museum.

Port Hedland (Figure 4). Examination of available *C. angusticeps* specimens also shows that patterning and colouration varies considerably between individuals. For example, a vertebral stripe is not consistently present (Figure 4).

Habitat

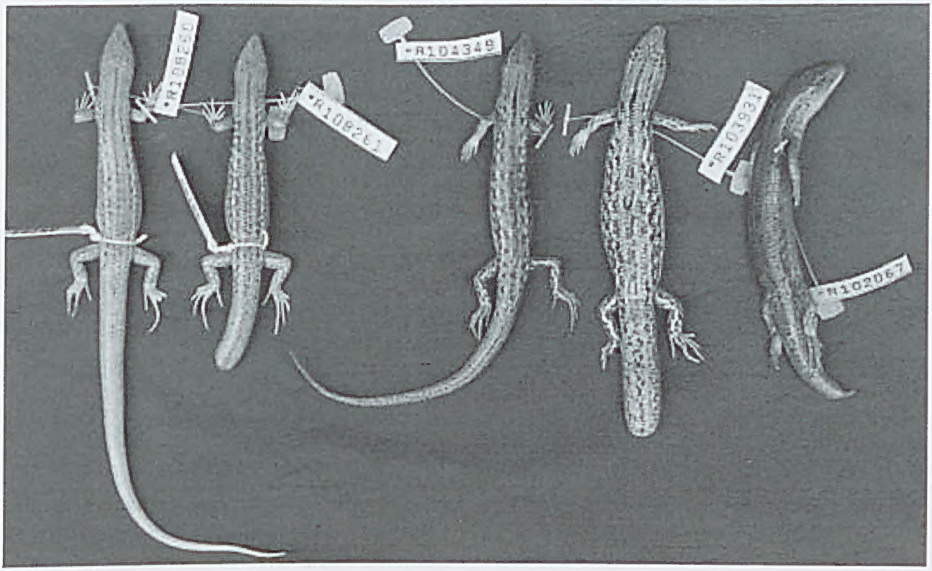
The *Ctenotus angusticeps* at Port Hedland were recorded from areas of low open heath adjacent to mangroves (see Figure 5). The substrate was a heavy, grey sandy clay, punctuated by numerous crab holes of varying sizes, and was subject to tidal influence, similar to the conditions described for the Roebuck Bay locality by Sadlier (1993). The single specimen was collected 5 m from the mangrove margin.

Vegetation where *Ctenotus angusticeps* was observed at Port Hedland comprised:

1. Low open heath of *Muellerolimon salicorniaceum*, *Tecticornia halocnemoides* subsp. *tenuis*, and *Suaeda arbusculoides* over *Sporobolus virginicus* open tussock grassland with scattered *Avicennia marina* shrubs and *Triodia secunda* scattered hummock grassland;

2. *Muellerolimon salicorniaceum* low open heathland; and

Figure 4. Individuals from Roebuck Bay (two left) and Airlie Island (three right).



3. *Muellerolimon salicorniaceum, Tecticornia halocnemoides* subsp. *tenuis* low open heathland over *Sporobolus virginicus* open tussock grassland over *Triodia secunda* very open hummock grassland.

In these areas minor occurrences of other species included *Frankenia ambita, Hemichora dryandra* and *Ceriops tagal*. All *C. angusticeps* locations were adjacent to the intertidal zone and dense mangroves, predominantly Grey Mangrove (*Avicennia marina*) with occasional Red Mangrove (*Rhizophora stylosa*). Further inland, dense areas of *Triodia epactia* hummock grassland occurred.

Behaviour

Although only brief views of the animals were given, some short notes on behaviour were made. The first individual was captured after a short chase, during which it retreated under several low samphire shrubs. Attempts to capture the next three (larger, presumably adult) individuals were unsuccessful because, while the animals initially sought refuge under samphire, they quickly disappeared into one of many nearby crab holes. First impressions in all cases were of a relatively slow, drab, unmarked or lightly marked olive-grey lizard, not unlike *Ctenotus pantherinus*.

DISCUSSION

The specimen collected was considered to be a juvenile based on its small size relative to those in the Western Australian Museum collection, all of which are considered to be adults, with an average SVL of 62 mm. It is currently the only juvenile of the species in a museum collection and consequently it differs in colouration and pattern to the adult form as recorded above. However, the specimen bears a greater resemblance to the photograph of *C. angusticeps* from Roebuck Bay in Sadlier (1993) who noted that there was a difference in the colouration between the Roebuck Bay and Airlie Island populations and that some Roebuck Bay individuals '[have] a more muted colour pattern overall' (Sadlier, 1993).

The addition of this record to the known distribution of the species, in habitat consistent

Figure 3. Location at which *Ctenotus angusticeps* was collected in mixed halophytic shrubland

with that at Roebuck Bay, suggests that the species may occur along much of the north-west coast, as proposed by Sadlier (1993). Samphire flats - level plains (with samphire shrubland and *Sporobolus virginicus*) slightly raised above the adjacent bare tidal flats, are widespread in the Pilbara region and occur typically up to 2 km long and 500 m wide (Van Vreeswyk *et al.*, 2004).

The lack of records of *C. angusticeps* in Port Hedland may be considered surprising given historical and planned developments on the north-west coastline associated with mining, oil and gas. Light and heavy industry feature in the landscape surrounding the newly-discovered population, which has remained unknown in the region despite surveys associated with development. This could be due to restricted or specialised habitat requirements or to a lack of survey effort within the favoured habitat of *C. angusticeps*. As demonstrated here, as well as by Browne-Cooper and Maryan (1990) and Sadlier (1993), *Ctenotus angusticeps* may be observed at various times of the day. We would suggest that intensive trapping utilising funnel-type traps is the most effective means to sample for this species.

It is hoped that the habitat described in this paper will receive particular attention during surveys along the north-west coastline, and uncover additional populations of this enigmatic and potentially overlooked lizard.

ACKNOWLEDGMENTS

Thanks to Brad Maryan (Western Australian Museum) for reviewing the draft and providing access to museum specimens, Dr Jerome Bull for botanical identification and Morgan O'Connell from Biologic Environmental Survey for financial support.

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THE OLDEST CAPTIVE AUSTRALIAN SNAKE? A LONGEVITY RECORD FOR A CHAPPELL ISLAND TIGER SNAKE (*NOTECHIS SCUTATUS*) IN TASMANIA

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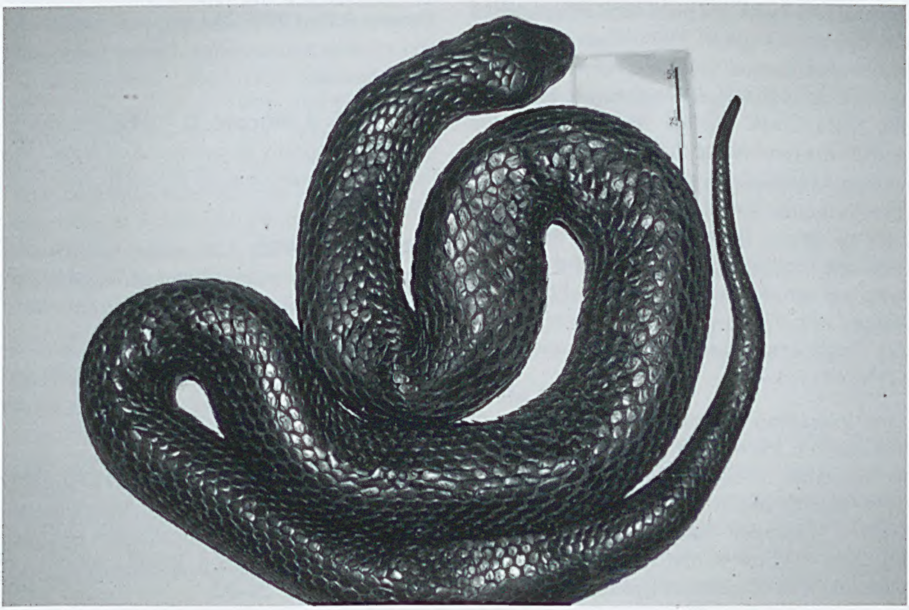
Determining the maximum age of any individual snake under natural conditions would involve marking an individual at birth and being able to reliably record the date of its death possibly decades later. Given the cryptic habits of many snake taxa, it is not surprising that such data do not exist for wild specimens. Longevity records for individual snakes are rarely reported and have always involved captive specimens. The longest-lived captive snake on record anywhere in the world appears to be a Ball Python (*Python regius*) (Pythonidae) that was received at the Philadelphia Zoo, USA as a young adult and died 47 years later (Ernst & Zug, 1996). Ross and Marzec (1990) report individual captive green pythons (*Morelia viridis*) attaining 20 years of age. Among the Viperidae, individual Timber Rattlesnakes (*Crotalus horridus*) have lived in captivity for >25 years (Ernst & Zug, 1996) and a Canebrake Rattlesnake (*C. horridus atricaudatus*) lived for 36.5 years in a college laboratory (Rubbio, 1998). Greer (1997) tabulated longevity records for captive Australian Elapidae with the record being 19 years for a Broad Headed Snake (*Hoplocephalus bungaroides*) and Bush *et al.* (2010) record a captive female Western Australian tiger snake (*Notechis scutatus*) living for 13 years, 4 months. Given the large number of

Figure 1. Adult female Chappell Island tiger snake (*Notechis scutatus*) shortly after death at 22.75 years of age (Photo: S. Fearn).



snakes across all families that have been held in captivity in Australia for many years, it would appear surprising that so few longevity records for captive snakes are documented. However, licensing and permit systems for the private keeping of native reptiles throughout much of Australia do not encourage honest reporting of snake longevities. Many supposedly captive bred specimens are illegally replaced when they die with wild-caught animals. This may occur several times so that a twenty year old snake on Government Faunal Return Forms may in fact represent several individuals, thus keeping the animal "alive" on paper work (S. Fearn, pers. obs.).

In this work we report on a female Chappell Island tiger snake (*Notechis scutatus*) that was born in captivity to a wild-caught female in the first week of April 1987 and died on 6 January 2011 aged 22 years, 9 months (Figure 1). This appears to be the oldest captive elapid snake on record for Australia and possibly the world. This snake was raised by one of us (IN) and was initially housed in an indoor cage for the first three years or so until approximately one metre in length. At this size the snake was transferred to an outdoor enclosure with other N. scutatus for several years where it gave birth to a clutch of 18 neonates in April 1991. From 1993 the snake was loaned to reptile keeper J. Drake as well as spending some time on display at the Mole Creek Wildlife Park. In 2001 the snake was returned to the second author and was maintained in an outdoor enclosure (where it gave birth to 47 neonates in 2005) until its death. Throughout its life the snake was fed laboratory mice, rats and day-old hatchery chickens. This snake has been lodged with the Queen Victoria Museum and Art Gallery in Launceston (Registration No. QVM:2011:3:1).

One interesting aspect of the life history of this snake is the modest size it grew to (snout to vent length 1188 mm, tail 197 mm, weight 1200 g at death) in spite of being a well-fed captive. Chappell Island tiger snakes are reported to grow to the largest size of any population of *N. scutatus* typically growing to body lengths in excess of 1.5 m (Schwaner & Sarre, 1988). However, neonate mortality on Chappell Island is very high with intense selection pressure due to a limited supply of skink lizards that favours the largest snakes that can attain a size to consume 64 g nestling shearwater chicks in as short time as possible (Schwaner, 1990). Without the intense selection pressures experienced by wild snakes, captive-reared neonates would be expected, statistically, to be individuals that would not have survived to adulthood on the island. This may explain why in a combined total of 50 years of keeping and breeding Chappell island tiger snakes, the authors have had no captive raised specimens grow as large as maximal-sized wild specimens regardless of how long they live or how much food they receive.

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THE FROG DIVERSITY OF THE PAMBULA RIVER FLOODPLAIN IN SOUTH-EASTERN NEW SOUTH WALES

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INTRODUCTION

The Bega Valley local government area (LGA) covers an area of approximately 6,052 square kilometers and comprises the well-known coastal towns of Bermagui, Tathra, Merimbula and Eden. The LGA includes almost 106 kilometres of coastline and to the west, reaches the higher peaks of the Great Dividing Range reaching beyond 1000 m above sea level. This fluctuation in topography has led to the development of diverse coastal floodplains, the majority now supporting intensive agricultural activities.

A recent literature review revealed that 26 frog species have been previously recorded in the LGA confirming a relatively high amphibian diversity (EnviroKey, 2011). However, the majority of past studies and previous surveys are from within the forests of national parks, state forests and nature reserves (Daly, 1998, 2007; Daly *et al.*, 2002; Daly & Senior, 2001, 2003; Lemckert *et al.*, 1997, 1998; Lunney & Barker, 1986; NGH 2008; Penman, 2005; Penman *et al.*, 2004, 2006, 2008) highlighting a paucity of data on frogs relative to other land tenures. Further, less than 3% of all frog records within the LGA come from coastal floodplains despite frog communities being considered an important component of floodplain biota (Healey *et al.*, 1997).

The Pambula River floodplain comprises a series of diverse estuarine and freshwater wetlands which are now, in many parts, dominated by agricultural activities. A 77 hectare portion of the floodplain is now managed by the Management Committee of Pambula Wetlands and Heritage Project Inc. in conjunction with the Pambula Wetlands and Heritage Reserve Trust for the purpose of conservation and restoration of a previously agricultural dominant landscape. This area is known as 'Panboola'.

With little known of the frog diversity of the Pambula River floodplain, the aim of this manuscript is to document the frog species present at 'Panboola', including a review of previous records and provision of a systematic survey. Discussion is also provided on the likelihood of occurrence for unrecorded species.

METHODS

Study Area

'Panboola' is located on the NSW far south coast. It is broadly flanked by Ben Boyd National Park to the east, Pambula River to the south, the Princes Highway and agricultural land to the west and the town of Pambula to the north (Figure 1).

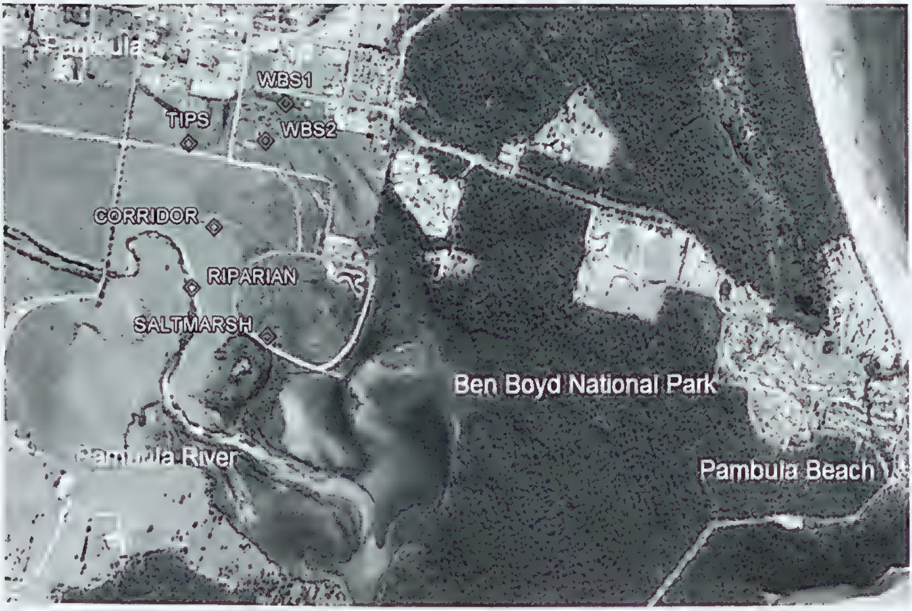
Desktop Analysis

A desktop analysis was conducted to gain an understanding of the frog species previously recorded within the general locality of 'Panboola'. This comprised searches of the NSW BioNet database and records of the Australian Museum focusing on a 10 km radius from the centre point of the study area.

Field Surveys

Six survey sites were established at 'Panboola' with the aim of including the full range of habitats within the study area. This approach had the objective of detecting the full diversity of frog species that could occur within the study area. Two sites were established within

Figure 1. Location of the six survey sites for this study.



permanent freshwater wetlands (Tips Billabong, Waterbird Sanctuary 1), two sites within ephemeral freshwater wetlands (Corridor, Waterbird Sanctuary 2), one site within estuarine coastal saltmarsh (Saltmarsh) and one site within the riparian vegetation flanking the Pambula River (Riparian). Figure 1 details the location of the six survey sites.

Nocturnal surveys for frogs were undertaken at each of the six sites on three occasions (27–28 October and 7–8 December 2010). This resulted in a total of 18 surveys and a total survey effort of approximately 13.2 hours. A single frog survey comprised of a combination of listening for frog calls, spotlighting, active searching of habitat where possible and call playback of threatened frog species within a 50 m radius of the site marker. At the commencement of each frog survey, a two-minute listening period was undertaken to record any species heard calling. Call playback was chosen for the threatened Green and Golden Bell Frog (*Litoria aurea*) given that 'Panboola' is likely to have supported populations of this species in the past (DECC, 2005; NPWS, 1999; White & Pyke, 1996). Calls of this species were played for a period of two-minutes. This was followed by a further two-minute listening period.

Active searches and spotlighting were then conducted over 40-person minutes and call recognition was also used to identify any frog species calling. Species heard or observed within a 50 m radius of the site were recorded with an approximation of their abundance made by estimating the numbers of frogs calling. This is represented by a ranked scale of between 1 and 5 (1 = <10 frogs, 2 = 10–30 frogs, 3 = 30–50 frogs, 4 = 50–100 frogs, 5 = >100 frogs).

Weather conditions at the time of the surveys and rainfall within the preceding week were considered conducive to detecting frogs. Temperatures and rainfall data were drawn from Merimbula Airport weather station (5 km to the north) for the October and December surveys. During the October survey, tempera-

tures ranged between 6° C (minimum) and 19.2° C (maximum) with 21 mm of rainfall in the 7 days prior to the survey. During the December survey, temperatures ranged between 17.1° C (minimum) and 24.9° C (maximum) with 107 mm of rainfall in the 7 days prior to the survey.

Protocols for the control of disease were implemented at all times as outlined within 'Hygiene Protocols for the control of disease in frogs' (DECC, 2008b). Nomenclature adopted for this study follows Tyler and Knight (2009) with the exception of *Litoria dentata* which is more commonly referred to as the Bleating Tree Frog.

Table 1. Frog species, their legal status and the number of individuals recorded within a 10 km radius of 'Panboola'. Data from DECCW NSW Atlas of Wildlife and Australian Museum records (P = Protected, V = Vulnerable, E = Endangered, TSC = NSW *Threatened Species Conservation Act 1995*, EPBC = *Environment Protection and Biodiversity Conservation Act 1999*).

Common name	Scientific name	Legal status	No. of individuals
Common Froglet	*Crinia signifera*	P	59
Giant Burrowing Frog	*Heleioporus australiacus*	V TSC V EPBC	7
Eastern Banjo Frog	*Limnodynastes dumerilii*	P	3
Striped Marsh Frog	*Limnodynastes peronii*	P	24
Haswell's Froglet	*Paracrinia haswelli*	P	3
Bibron's Toadlet	*Pseudophryne bibronii*	P	3
Tyler's Toadlet	*Uperoleia tyleri*	P	4
Green and Golden Bell Frog	*Litoria aurea*	E TSC V EPBC	6
Blue Mountains Tree Frog	*Litoria citropa*	P	1
Bleating Tree Frog	*Litoria dentata*	P	2
Ewing's Tree Frog	*Litoria ewingii*	P	48
Eastern Dwarf Tree Frog	*Litoria fallax*	P	2
Jervis Bay Tree Frog	*Litoria jervisiensis*	P	6
Lesueur's Frog	*Litoria lesueuri*	P	12
Peron's Tree Frog	*Litoria peronii*	P	98
Narrow Fringed Frog	*Litoria nudidigitus*	P	21
Verreaux's Tree Frog	*Litoria verreauxii*	P	20

RESULTS

Desktop Analysis

The desktop analysis revealed a total of 17 species of frog and a total of 319 records within a 10 km radius of 'Panboola' (Table 1). This includes two species listed under the schedules of the NSW *Threatened Species Conservation Act* 1995 and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999: the Giant Burrowing Frog (*Heleioporus australiacus*) and the Green and Golden Bell Frog (*Litoria aurea*).

Field Surveys

Field surveys during this study revealed a total of eleven frog species (Table 2).

When pooling data from each site for the three surveys, six frog species were recorded at each of the sites Corridor, Saltmarsh, Tips Billabong and Waterbird Sanctuary 1 (WBS1) (Table 3). The Riparian site had the lowest frog species diversity with only two species recorded.

Species Abundance

The highest level of abundance recorded was for Common Froglet (*Crinia signifera*) at WBS1 during the October survey (Table 3) and Bleating Tree Frog (*Litoria dentata*) at Corridor during the December survey (Table 4).

Relative abundance was higher during the December surveys in comparison to the October surveys. At Corridor, both diversity and abundance was notably different ranging from no frog species in October to six frog species present during December, with *L. dentata* the most abundant with 50–100 individuals calling (Table 4).

Species Distribution

Some frog species were recorded at all, or the majority of the survey sites during this study. *Crinia signifera* were recorded at every survey site while Striped Marsh Frog (*Limnodynastes peronii*), Peron's Tree Frog (*Litoria peronii*) and Verreaux's Tree Frog (*Litoria verreauxii*) were recorded at all survey sites with the exception of the Riparian site.

Table 2. Frog species recorded on the Panboola River Floodplain (calling or observed). (C= Corridor, R = Riparian, S = Saltmarsh, T = Tips Billabong, WBS = Waterbird Sanctuary).

Common Name	Scientific Name	C	R	S	T	WBS1	WBS2
Common Froglet	*Crinia signifera*	*	*	*	*	*	*
Eastern Banjo Frog	*Limnodynastes dumerilii*			*			
Striped Marsh Frog	*Limnodynastes peronii*	*		*	*	*	*
Spotted Grass Frog	*Limnodynastes tasmaniensis*					*	
Bleating Tree Frog	*Litoria dentata*	*		*			
Ewing's Tree Frog	*Litoria ewingii*	*			*		
Jervis Bay Tree Frog	*Litoria jervisiensis*					*	
Peron's Tree Frog	*Litoria peronii*	*		*	*	*	*
Verreaux's Tree Frog	*Litoria verreauxii*	*		*	*	*	*
Bibron's Toadlet	*Pseudophryne bibronii*		*				
Smooth Toadlet	*Uperoleia laevigata*				*		

Conversely, three species of frog were recorded on only one occasion and at only one survey site: the Eastern Banjo Frog (*Limnodynastes dumerilii*) (at Saltmarsh), Smooth Toadlet (*Uperoleia laevigata*) (at Tips Billabong), and Bibron's Toadlet (*Pseudophryne bibronii*) (at Riparian).

DISCUSSION

Species Richness and Distribution

This study recorded a total of 11 frog species confirming the importance of floodplain habitats in the locality particularly in light of historical agricultural land use. Some frog species were detected at all or the majority of survey sites. Species such as Common Froglet (*Crinia signifera*), Striped Marsh Frog (*Limnodynastes peronii*) and Peron's Tree Frog (*Litoria peronii*) are the most widespread across the LGA (EnviroKey, 2011) and their distribution across 'Panboola' was no different.

A New Record for the locality

Uperoleia laevigata was recorded for the first time at 'Panboola', at Tips Billabong. There are only two previously documented records for this species in the Bega Valley LGA. These are approximately 1 km west of Wallagoot Lake and 2 km south of Candelo. both approximately 20 km (north and north-west respectively) from the study area. Habitat of this species is generally considered to be grassy areas within dry forests and woodlands (Robinson, 1998; Tyler & Knight, 2009). In this study, several individuals were heard calling at a grassy area adjacent to extensive stands of native reed within a freshwater billabong. Personnel experienced with the calls of the two *Uperoleia* known from the far south coast (*U. laevigata* and *U. tyleri*) (SS) confirmed that the call was that of *U. laevigata*.

Table 3. Pooled ranked abundance data from frog surveys completed on 27 and 28 October 2010. (C = Corridor, R = Riparian, S = Saltmarsh, T = Tips Billabong, WBS = Waterbird Sanctuary; ranking: 1 = <10 frogs calling, 2 = 10–30 frogs, 3 = 30–50 frogs, 4 = 50–100 frogs, 5 = >100 frogs

Common Name	Scientific Name	C	R	S	T	WBS1	WBS2
Common Froglet	*Crinia signifera*			2	3	4	2
Eastern Banjo Frog	*Limnodynastes dumerilii*						
Striped Marsh Frog	*Limnodynastes peronii*			1	2	3	1
Spotted Grass Frog	*Limnodynastes tasmaniensis*		(1 on boundary of site)				
Bleating Tree Frog	*Litoria dentata*						
Ewing's Tree Frog	*Litoria ewingii*						
Jervis Bay Tree Frog	*Litoria jervisiensis*					1	
Peron's Tree Frog	*Litoria peronii*					2	1
Verreaux's Tree Frog	*Litoria verreauxii*					2	1
Bibron's Toadlet	*Pseudophryne bibronii*						
Smooth Toadlet	*Uperoleia laevigata*				1		

This record provides additional information of relevance to the ecological knowledge and distribution of this species on the NSW far south coast pending the ongoing taxonomic review of this genus.

Detectability

Rainfall preceding the December surveys is likely to be the greatest contributing factor to detecting such high species richness at Panboola. Four species of frog were detected during the December surveys that were not recorded in October (*L. dumerilii, L. dentata, L. ewingii, P. bibronii*). Cooler temperatures during the October survey may have also influenced this. However, increased surface water is generally considered positively correlated with increased frog activity for many wetland frog species.

Notable Absences

Eight species of frog known from within a 10 km radius were not recorded at 'Panboola' during this study: Giant Burrowing Frog (*H. australiacus*), Haswell's Froglet (*Paracrinia haswelli*), Tyler's Toadlet (*Uperoleia tyleri*), *Litoria aurea*, Blue Mountains Tree Frog (*L. citropa*), Eastern Dwarf Tree Frog (*L. fallax*), Lesueur's Frog (*L. lesueuri*) and Narrow-fringed Frog (*L. nudidigitus*). Based on the proximity of previous records, *U. tyleri, P. haswelli* and *L. aurea* also have the potential to occur at 'Panboola'. The lack of trapping during this study (pitfall or funnel traps) may have resulted in a false absence being recorded for *U. tyleri* and *P. haswelli* given that both species have been recorded nearby using these methods (S. Sass, unpubl. data). For *L. aurea*, there are a number of records for this species close to Panboola and also a reintroduction trial nearby (Daly *et al.*, 2008) which has had limited success. The presence of open water bodies, *Melaleuca* thickets, extensive areas of emergent vegetation and connectivity to saltmarsh and estuarine areas suggest that habitat for *L. aurea* is present, based on habitat preferences for this species (Daly & Senior, 2003; DECC, 2005, 2008a; Hamer *et al.*, 2002, 2003, 2008; Lane *et al.*, 2007). As the reintroduced population of *L.*

Table 4. Pooled ranked abundance data from frog surveys completed on 7 and 8 December 2010. (C = Corridor, R = Riparian, S = Saltmarsh, T = Tips Billabong, WBS = Waterbird Sanctuary; ranking as for Table 3).

Common Name	Scientific Name	C	R	S	T	WBS1	WBS2
Common Froglet	*Crinia signifera*	1	1	2	2		2
Eastern Banjo Frog	*Limnodynastes dumerilii*			1			
Striped Marsh Frog	*Limnodynastes peronii*	2		3	1		1
Spotted Grass Frog	*Limnodynastes tasmaniensis*					2	
Bleating Tree Frog	*Litoria dentata*	4		3			
Ewing's Tree Frog	*Litoria ewingii*	1			1		
Jervis Bay Tree Frog	*Litoria jervisiensis*						
Peron's Tree Frog	*Litoria peronii*	3		1	3	3	1
Verreaux's Tree Frog	*Litoria verreauxii*	3		2	2		2
Bibron's Toadlet	*Pseudophryne bibronii*						
Smooth Toadlet	*Uperoleia laevigata*						

aurea occurs within 2 km of 'Panboola' and the species is known to move long distances in a single night through suitable habitats (Hamer *et al.*, 2008) , *L. aurea* may be able to recolonise this portion of the floodplain and a regular monitoring program should be implemented to determine future occupancy.

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A SURVEY OF THE FROG FAUNA OF THE COFFS CREEK URBAN BUSHLAND AT COFFS HARBOUR ON THE NEW SOUTH WALES NORTH COAST

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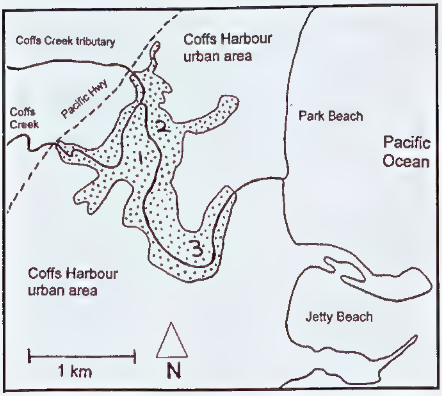
ABSTRACT

A survey of the frog fauna in the Coffs Creek urban bushland area, on the coastal plain in Coffs Harbour on the New South Wales north coast, was done over the period 1996–2002. A total of 17 species was recorded, representing eight genera: *Litoria* (Hylidae), *Adelotus, Limnodynastes* and *Platyplectrum* (Limnodynastidae) and *Crinia, Mixophyes, Pseudophryne* and *Uperoleia* (Myobatrachidae). Noteworthy findings included a population of the Northern Banjo Frog *Limnodynastes terraereginae* at the southern limit of the species' known coastal distribution, a population of the IUCN-listed Freycinet's Frog *Litoria freycineti* and a *Crinia* species of uncertain identity which may prove to be an undescribed narrow-range species.

INTRODUCTION

The town of Coffs Harbour (population 23000) is located 555 km north of Sydney in *Gumbaynggirr* Aboriginal Country in the New South Wales (NSW) north coast bioregion. Coffs Creek, a small coastal stream with a catchment area of about 25 km² and a total length of about 13 km (NSW Department of Natural Resources, 2008), flows through the middle of the Coffs Harbour urban area. The Coffs Creek urban bushland (30°18'S 153°07.5'E) comprises approximately 110 ha of remnant native vegetation along the lower reaches of the creek, east of the Pacific Highway (Figure 1). The creek here is estuarine and is bordered by mangroves and salt marsh. Low lying areas near the creek support swamp forests of Swamp Oak *Casuarina glauca*, Swamp Mahogany *Eucalyptus robusta* and Paperbark *Melaleuca quinquinervia* while higher ground (up to 10 m AHD) has open forest with Blackbutt *Eucalyptus pilularis*, Scribbly Gum *E. signata*, Needlebark Stringybark *E. planchoniana* and Turpentine *Syncarpia glomulifera*. Additional habitats include heath and small freshwater wetlands and ponds. The substratum is a low-nutrient sandy soil.

Figure 1. Location of the three study sites in the Coffs Creek urban bushland. 1 = North Coast Regional Botanic Garden, 2 = Lawson Crescent area, 3 = Brodie Drive area.



METHODS

Three survey areas in the Coffs Creek urban bushland were investigated: the grounds of the North Coast Regional Botanic Garden on the south side of the creek and the Lawson Crescent and Brodie Drive areas on the north side of the creek (Figure 1). The survey areas were visited at night, usually during or following rain. The Botanic Garden was visited on four nights over the period November 1996 – February 2002, the Lawson Crescent area on four nights over November 1996 – September 1997, and the Brodie Drive area on 20 nights over February 1997 – February 2001. Survey dates are listed in Appendix 1. On each visit between 30 minutes and two hours were spent searching for frogs. Active frogs

were located with a hand-held 50 watt spotlight while walking along trails and around the edges of ponds and wetlands or were identified by call.

Voucher specimens of *Crinia* frogs were collected by hand by the author in April 1998 (five animals) and February 2001 (nine animals) from a location in the Brodie Drive area where *Crinia signifera* and a *Crinia* species of uncertain identity were heard calling.

RESULTS

A total of 17 species was recorded in this study: eight hylids (one genus), four limnodynastid frogs (three genera) and five myobatrachid frogs (four genera). A list of the species recorded at each of the survey sites is presented in Table 1, including information on frequency of detection. Nomenclature follows Tyler and Knight (2011). *Crinia* species A refers to a taxon of uncertain iden-

Table 1. Number of nights on which frogs were recorded at three sites in Coffs Creek urban bushland.

Family	Species	Common Name	Brodie Drive (20 nights)	Botanic Garden (4 nights)	Lawson Cresent (4 nights)
Hylidae	*Litoria caerulea*	Green Tree Frog	4	1	-
	Litoria dentata	Bleating Tree Frog	7	2	-
	Litoria fallax	Eastern Dwarf Tree Frog	4	4	1
	Litoria freycineti	Freycinet's Frog	5	-	-
	Litoria gracilenta	Dainty Green Tree Frog	4	1	-
	Litoria latopalmata	Broad-palmed Frog	-	1	-
	Litoria peronii	Peron's Tree Frog	-	4	-
	Litoria tyleri	Tyler's Tree Frog	4	1	1
Limnodynastidae	*Adelotus brevis*	Tusked Frog	2	1	2
	Limnodynastes peronii	Brown-striped Frog	14	4	3
	Limnodynastes terraereginae	Northern Banjo Frog	11	-	-
	Platyplectrum ornatum	Ornate Burrowing Frog	1	-	-
Myobatrachidae	*Crinia signifera*	Common Froglet	9	1	-
	Crinia sp. A	-	7	-	-
	Mixophyes fasciolatus	Great Barred Frog	1	-	-
	Pseudophryne coriacea	Red-backed Toadlet	-	2	-
	Uperoleia fusca	Dusky Toadlet	5	-	1
Total species			14	11	5

tity, which was thought at the time to be either *Crinia parinsignifera* or *Crinia tinnula*, but which later genetic study indicated may be a cryptic undescribed species. Information concerning *Crinia* genus voucher specimens collected is provided in Appendix 2.

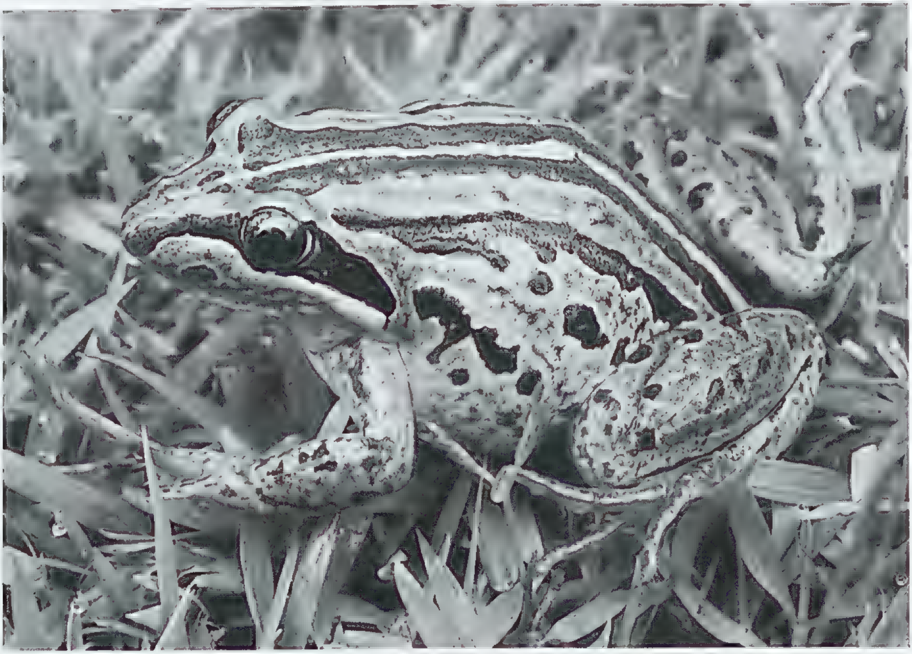
The most widespread (recorded at all three sites) and frequently recorded species in this study was *Limnodynastes peronii* (Figure 2). Other widespread species were *Adelotus brevis*, *Litoria fallax* and *Litoria tyleri*. Rarely recorded species (found at only one site, and on only one visit each) were *Litoria latopalmata*, *Platyplectrum ornatum* and *Mixophyes fasciolatus*. It should be noted that differences in species diversity between sites may in part reflect differences in survey effort.

Valuable habitats for frogs in the study area included Paperbark and Swamp Oak swamp forests, where large numbers of frogs congregated to breed in shallow ephemeral wetlands following heavy rain, as well as small permanent ponds with fringing reeds and rushes. Some of the swamp forest wetlands were only minimally above the spring high tide level of adjacent estuarine waters. Species recorded calling in these near-saline wetlands were *Litoria caerulea*, *Litoria dentata*, *Litoria gracilenta*, *Limnodynastes peronii*, *Crinia signifera*, *Pseudophryne coriacea* and *Uperoleia fusca*. Species found in permanent ponds included *Litoria dentata*, *Litoria fallax*, *Litoria peronii*, *Litoria tyleri*, *Adelotus brevis*, *Limnodynastes peronii* and *Mixophyes fasciolatus*. Species regularly found active on the forest floor distant from water were *Litoria freycineti*, *Limnodynastes peronii* and *Limnodynastes terraereginae*.

DISCUSSION

Comparison of the results of this survey with similar field studies at coastal plain sites to the south (Hamer, 1996) and north (Richard & Petzler, 2003) and with published broad dis-

Figure 2. Brown-striped Frog *Limnodynastes peronii*, Coffs Harbour urban area (Photo: M.J. Murphy, Dec 2005).



tribution maps (Barker *et al.*, 1995; Anstis, 2007; Tyler & Knight, 2011) demonstrate that the frog community of the Coffs Creek bushland is typical of the humid eastern coastal plain of Australia, with a northern rather than southern influence predominating. Southern species occurring on the NSW north coast but not found in this study include *Paracrinia haswelli* (Myobatrachidae) (Morante, 1999). Northern species present include *Litoria gracilenta, Adelotus brevis, Limnodynastes terraereginae, Pseudophryne coriacea* and *Uperoleia fusca*. *Limnodynastes terraereginae* (Figure 3) is at the southern known limit of its coastal distribution at Coffs Creek (Atlas of NSW Wildlife, database searched 1 November 2010). This species is also found west of the Great Dividing Range, extending much further south to the central west slopes of inland NSW (LeBreton *et al.*, 2002). At Coffs Creek *L. terraereginae* was found in an area of Blackbutt-Swamp Mahogany open forest with an understorey of wet heath species and was recorded as active between September and March with a peak in November.

It is also interesting to compare the frog fauna of Coffs Creek with the nearby Bruxner Park Flora Reserve and adjoining Ulidarra National Park, located at an elevation of 120–414 m AHD on the sub-coastal escarpment 3 km to the north-west. A total of 21 frog species is known from the 1090 ha Bruxner-Ulidarra reserves, comprising two distinct frog communities: one associated with streams in rainforest and tall open forest and another associated with temporary ponds in drier open forest (Murphy & Murphy, 2011). The frog community of the Coffs Creek bushland corresponds closely to the open forest frog community of the Bruxner-Ulidarra reserves, sharing many species including *Litoria dentata, Litoria gracilenta, Litoria latopalmata, Limnodynastes peronii, Crinia signifera, Mixophyes fasciolatus* and *Uperoleia fusca*. Three species from Coffs Creek,

Figure 3. Northern Banjo Frog *Limnodynastes terraereginae*, Coffs Creek Bushland (Photo: M.J. Murphy, Feb 1997).

Litoria freycineti, Limnodynastes terraereginae and *Crinia* sp. A, were not detected in the Bruxner-Ulidarra reserves despite nine years of survey there (Murphy & Murphy, 2011).

Litoria freycineti (Figure 4) has been identified as a species of conservation concern. Although not currently listed as a threatened species in NSW legislation it is listed as vulnerable under the Queensland *Nature Conservation Act 1992* and the IUCN Red List of Threatened Species (IUCN, 2010). *Litoria freycineti* is generally found in coastal wet heath and temporary coastal swamps, ranging from Fraser Island in south-east Queensland to Jervis Bay in southern NSW (Meyer *et al.*, 2006). The species' distribution is severely fragmented with a continuing decline in extent and quality of habitat (IUCN, 2010). Current threats include clearing of habitat for development and degradation of habitat through altered hydrological regimes, increased nutrient and sediment loads and invading weeds (Hazell, 2003; Meyer *et al.*, 2006; IUCN, 2010). At Coffs Creek *L. freycineti* was found in Swamp Mahogany-Blackbutt-Paperbark swamp forest and was recorded as active between November and March with a peak in February.

Crinia species A was first recorded (by call) in February 1997. Although regularly recorded (Table 1), the species was only found at a single location over the course of the study, along a small drainage line in Swamp Mahogany-Blackbutt-Paperbark swamp forest in the Brodie Drive area. Frogs were recorded between November and April, calling by day and night during and following rain, often in mixed choruses with *Crinia signifera*. Calling sites were at ground level within dense stands of the cord-rush *Restio tetraphylla* and the fern *Gleichenia dicarpa*. The call was a slowly repeated high pitched short note, often finishing with alternating higher and lower pitched shorter notes in a more rapid see-sawing series. The call was broadly similar to those of *Crinia parinsignifera* and *Crinia tinnula*, with the note length intermediate between the short sharp notes of *C. tinnula* and the longer, drawn-out notes of *C. parinsignifera*. Subsequent analysis of mito-

Figure 4. Freycinet's Frog *Litoria freycineti*, Coffs Creek Bushland (Photo: M.J. Murphy, Feb 1997).

chondrial DNA from voucher specimens collected during this survey indicated that *Crinia* sp. A may be a new taxon, most closely related to *C. tinnula* (Read *et al.*, 2001; S. Keogh, Australian National University, pers. comm. 2010). A specimen of *Crinia* sp. A identified by Read *et al.* (2001) is lodged in the Australian Museum (Sydney) (R165466; field tag AMH 45820) with a tissue sample (26421) in the South Australian Museum Australian Biological Tissue Collection. Some of the other specimens from the 1998 and 2001 field collections are also considered likely to be this taxon (M. Mahony, University of Newcastle, unpublished data 2002; S. Keogh, pers. comm. 2010). The potential identification of a new taxon arising from this survey highlights the value of lodging of voucher specimens in Museum collections. Further research is needed to resolve the taxonomic status of *Crinia* sp. A. It remains known only from the one location at Coffs Creek. The total population may be quite small (less than 100 individuals) and the taxon should be considered at moderate to high risk of extinction. The site was visited again in October 2010 and the continued occurrence of the taxon there was confirmed, with about six animals heard calling.

The introduced Cane Toad *Bufo marinus* (Bufonidae) was not recorded in this study. The species has not to date established a population at Coffs Harbour, although occasional translocated individuals have been recorded there (pers. obs.) and populations are established both to the north at Yamba (100 km north) and the south at Port Macquarie (130 km south) (NSW Scientific Committee, 2006). The risk of colonisation of the Coffs Creek urban bushland by *B. marinus* is very high. A substantial adverse impact on native fauna, through a combination of competition, predation and poisoning, can be expected if the species does become established in the area (Burnett, 1997; Philips *et al.*, 2003; NSW Scientific Committee, 2006).

Some of the species recorded in this study, such as *Litoria caerulea, Litoria dentata* and *Limnodynastes peronii*, occur widely in the surrounding Coffs Harbour urban area, while others such as *Limnodynastes terraereginae, Mixophyes fasciolatus* and *Pseudophryne coriacea* are restricted to bushland remnants within the urban area (pers. obs.). The Coffs Creek urban bushland retains some connectivity along the upper reaches of the creek to other areas of native vegetation; however, continuing rapid urban expansion in Coffs Harbour is making these linkages increasingly tenuous.

Urban bushland remnants face a range of threats including isolation and extinction debt (where isolated populations too small to remain viable decline to local extinction), infiltration by exotic weeds, pollution of streams and wetlands, alteration to drainage patterns as a result of urban stormwater management, alteration to natural fire regimes, predation of wildlife by domestic cats and dogs, wildlife fatality on surrounding roads and even 'rescue' and relocation of urban wildlife to outside the urban area by well-intentioned local residents. The Coffs Creek bushland is also at particular risk from anthropogenic climate change, given its low elevation and proximity to the coastline, so that even a minor increase in sea level or coastal erosion processes may threaten the area's freshwater wetlands and swamp forests. The information documented here will assist management of the Coffs Creek urban bushland area and provides a benchmark for future assessment of any changes to the frog fauna of the area.

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Appendix 1. Survey dates for Coffs Creek bushland frog survey.

Brodie Drive area		Botanic Garden	Lawson Crescent area
14.ii.1997	18.iv.1998	25.xi.1996	29.xi.1996
15.ii.1997	8.xi.1998	2.xii.1996	3.xii.1996
11.iii.1997	28.xi.1998	4.ii.1997	30.iii.1997
22.iii.1997	29.i.1999	19.ii.2002	10.ix.1997
30.iii.1997	13.iii.1999		
10.ix.1997	21.iii.1999		
8.x.1997	13.iv.1999		
5.xi.1997	4.xi.2000		
7.i.1998	14.xi.2000		
18.ii.1998	2.ii.2001		

Appendix 2. Voucher specimens of *Crinia* from Brodie Drive area, Coffs Creek.

18 April 1998. Specimens lodged in Australian Museum, Sydney, with tissue samples in South Australian Museum Australian Biological Tissue Collection:

R165466 (AMH 45820) + ABTC 26421

R165467 (AMH 45821) + ABTC 26422

R165468 (AMH 45823) + ABTC 26424

R165469 (AMH 45824) + ABTC 26425

R165496 (AMH 45822) + ABTC 26423.

2 February 2001. Specimens currently held by Michael Mahony, University of Newcastle:

AMH field tag numbers 50060-50068.

OBSERVATIONS AND CAPTURE OF AN INTRODUCED GREEN IGUANA, *IGUANA IGUANA* (LINNAEUS, 1758), IN TROPICAL QUEENSLAND, AUSTRALIA

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INTRODUCTION

Introduced species can have numerous ecological and economic impacts in their non-native ranges (Perrings *et al.*, 2000; David, 2009; Pimentel, 2011). Green Iguanas (*Iguana iguana* [Linnaeus, 1758]) are native to Central and South America, but they have been introduced successfully to at least 14 distinct localities worldwide (Krysko *et al.*, 2007; Kraus, 2009). Although the impacts of Green Iguanas in their introduced ranges have not been studied extensively, iguanas may compete with native species, disperse seeds of invasive plants, damage landscape vegetation, cause erosion of drainage canals and other structures through burrowing, pose airstrike hazards at airports, and act as great nuisances to land managers and property owners (Engeman *et al.*, 2005; Krysko *et al.*, 2007; Sementelli *et al.*, 2008; Engeman *et al.*, 2011).

In Australia, it is illegal to import Green Iguanas or keep them or other non-native reptiles as pets, but evidence suggests that iguanas are held illegally in Australia. Green Iguanas were detected frequently by border and post-border Australian biosecurity agencies between 1999 and 2010 (Henderson & Bomford, 2011; Henderson *et al.*, 2011). A total of 23 Green Iguanas were detected in 13 incidents during this time period; of these, there were 17 individuals (in 10 incidents) confiscated from private keeping, 5 individuals (in 2 incidents) confiscated at the border, and 1 individual detected as a stowaway entering Australia (Henderson & Bomford, 2011). Despite this, there are currently no known introduced populations of Green Iguanas in Australia (Kraus, 2009). However, this species is considered to pose an extreme risk of establishment because of large areas of suitable climate in northern and coastal regions of Australia (Henderson & Bomford 2011; Henderson *et al.*, 2011). Here, I report my observations of a Green Iguana that I found in the wild in tropical Queensland; this represents the first known record of a sighting of a Green Iguana in the wild in Australia (Henderson & Bomford, 2011; W. Henderson, Invasive Animals Cooperative Research Centre, personal communication).

OBSERVATIONS AND CAPTURE

On 16 April 2011, I went kayaking on the Ross River in Townsville, Queensland, Australia. Around 1530 hrs I paddled up Jensen Creek, a small stream flowing through the Townsville Palmetum Botanic Gardens, and saw a large green lizard with spines down its back, which I suspected was a Green Iguana. The lizard was partly submerged in the water along the stream bank, and was located approximately 75 m from the confluence with the Ross River. I took a photograph of the lizard and attempted to approach it, but it swam away and could not be relocated. From my photograph, Peter Harlow (Taronga Zoo) and Lin Schwarzkopf (James Cook University) confirmed that the lizard was a Green Iguana, and Eric Vanderduys (CSIRO) later confirmed this identification upon capture.

In coordination with Biosecurity Queensland, CSIRO, and James Cook University, a team of volunteers and I conducted day and night surveys in the Palmetum Botanic Gardens for the iguana. At approximately 0800 hrs on 21 April 2011, the iguana was observed climbing up a tree overhanging Jensen Creek; it was approximately 20 m above the stream, and 20 m from the location where I observed

Figure 1. The female Green Iguana (*Iguana iguana*) discussed in this article.

it initially. The iguana was captured around 1500 hrs by a person elevated in a basket by a crane; a noose on the end of a 2 m-long pole was slipped over the iguana's head to capture it. A veterinarian contracted by Biosecurity Queensland (who requested to remain anonymous) determined that the iguana was an adult female (Figure 1; body mass 1.2 kg, snout-vent length 300 mm, tail length 565 mm) and was not gravid at the time of capture. The lizard was found to be in good condition (condition score 3/5), and had been eating mainly figs, as these was the main contents of its digestive tract. In accordance with the Australian Environment Protection and Biodiversity Conservation Act, the lizard was euthanased soon after capture, and the specimen was destroyed.

Upon capture, the iguana was very docile, and it had scars from abrasions on its nose, as often found in captive reptiles that rub their noses against their enclosures, suggesting that the iguana was a released or escaped pet. No other Green Iguanas were observed during our surveys; therefore, it is likely that the captured iguana was not part of a larger breeding population.

ACKNOWLEDGMENTS

I thank Robert Cobon (Biosecurity Queensland), Eric Vanderduys (CSIRO), and volunteers from James Cook University, especially Richard Duffy, Angus McNab, and David Pike, for help with the iguana surveys and capture. Arborcare SEQ provided the crane and operating team; these costs were covered by the Townsville City Council. David Pike provided comments on the manuscript. I was supported by a James Cook University Postgraduate Research Scholarship during manuscript preparation.

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A RANGE EXTENSION FOR *DEMANSIA QUAESITOR* SHEA & SCANLON

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INTRODUCTION

Demansia species are slender, large-eyed, fast-moving elapid snakes that feed diurnally on fast-moving lizards (Shine, 1980). *Demansia* has proven to be one of the most taxonomically puzzling elapid genera with numerous, often conflicting, taxonomic arrangements (Boulenger, 1896; Loveridge, 1934, 1949; Kinghorn, 1942; Worrell, 1952, 1956, 1961a, 1961b, 1963; Storr, 1978; Shea, 1998). However, recent work aided by larger samples of specimens, as well as evidence of sympatry, has supported the recognition of nine species among what were previously considered two species, *D. olivacea* and *D. torquata* (Shea & Scanlon, 2007). One of the newly described species, *D. quaesitor*, is a small snake (maximum SVL 565 mm) with 182-195 ventrals, a blue-grey to orange-brown head, a dark transrostral streak through orbit to a dark postocular teardrop marking extending across top of fifth and middle of sixth upper labials, often connecting to ventral extremity of distinct dark collar on nape (Shea & Scanlon, 2007). This species was previously confused with *D. olivacea* despite the latter being collarless and having a lower ventral count (male means 179.0 vs 188.5; female means 176.3 vs 189.8) (Shea & Scanlon, 2007). Currently *D. quaesitor* is known from the east Kimberley of Western Australia, through southern Arnhem Land, and east to Doomadgee, Queensland (Shea & Scanlon, 2007; Wilson & Swan, 2010). Peripheral to this range are two marginal populations, one on Koolan Island, in the west Kimberley, Western Australia and one south-east of Doomadgee in central-western Queensland (Shea & Scanlon, 2007; Wilson & Swan, 2010). *Demansia olivacea* is found from the north Kimberley through the Top End of Northern Territory (Shea & Scanlon, 2007; Wilson & Swan, 2010).

OBSERVATION

At 1430 hrs on 20 February 2011, an adult *Demansia quaesitor* was found under a loose rock on a ridge 4.1 km north-east of the Snake Creek Bunkers, Adelaide River Township (13°13'S 131°7'E), Northern Territory. On being disturbed, the snake retreated among larger boulders and was not located again. At 1440 hrs, approximately 50 m from the first sighting, a second *D. quaesitor* (Figure 1) (adult male, 550 mm snout vent length, total length 722 mm, mass 30 g, 182 ventral scales; NTM R36483) was found beneath a loose rock. This specimen was captured as it attempted to escape among larger rocks. At the time of observation the air temperature was 30.3° C, the weather overcast and humidity high.

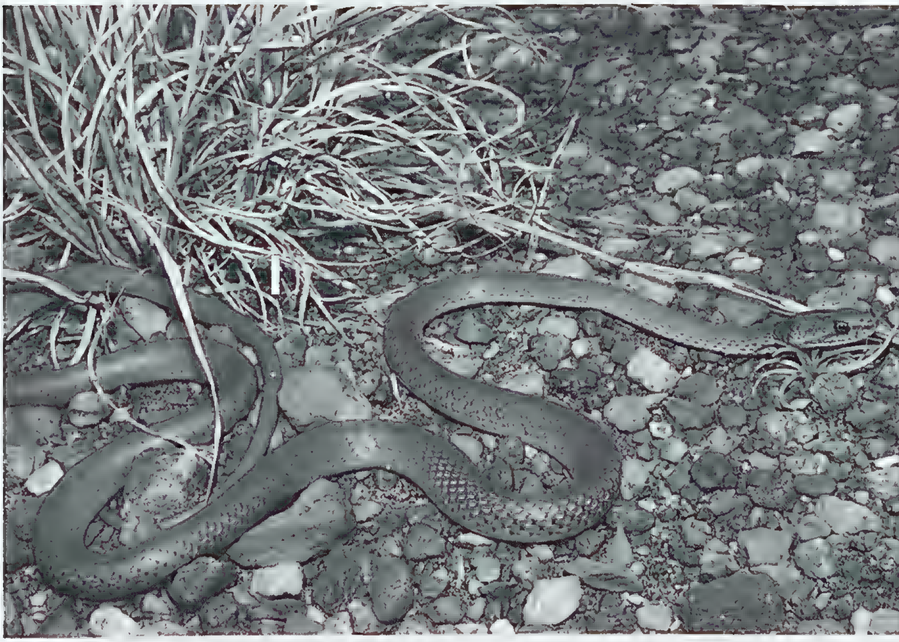
DISCUSSION

This record extends the range of *D. quaesitor* 201 km northwest of its previous northern limit in the western part of the Top End (Australian Museum R13047, Katherine; Shea & Scanlon, 2007). Although the new record was believed to be the first from the area, Wilson and Swan (2010) pictured an individual from Burrell Creek, 5.75 km east of Snake Creek, although their distribution map does not include this locality in its range.

The new localities are of significance as they greatly extend the known overlap in distribution of this species with *D. olivacea* (Shea & Scanlon, 2007; Wilson & Swan, 2010) strengthening the evidence for the two species being distinct.

Shea and Scanlon (2007) considered the Koolan Island population in the west Kimberley to be a western isolate, and only tentatively referred the population to this species. Since the description of the species, there have been a number of new records of the

Figure 1. ***Demansia quaesitor*** **(NTM R36483) from near Adelaide River, NT, in life.**



species from Koolan Island (Western Australian Museum R158003, R158046, R158047, R158048, R158053, R165788, R171654, R171655, R171656, R171657), as well as three specimens (WAM R168450, R169975, R169976) from Yampi Peninsula in the West Kimberley (P. Doughty, pers. comm.), providing evidence that the Koolan island population may not be a western isolate, but the end of a continuous distribution through the Kimberley.

Together, these new records indicate that *D. quaesitor* has a significantly wider distribution than previously ascribed.

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RECENT RECORDS OF THE WOMA PYTHON (*ASPIDITES RAMSAYI*) IN SOUTH AUSTRALIA, WITH AN EVALUATION OF DISTRIBUTION, HABITAT AND STATUS

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ABSTRACT

The Woma Python (*Aspidites ramsayi*) is a large and iconic arid zone python that has declined in many parts of its range across Australia. Although anecdotally regarded as relatively common in some parts of inland South Australia, there is little detailed information regarding its status, distribution, habitat preferences or the significance of potential threats. This study aimed to gain current information on these aspects of Woma Python ecology by utilising the high level of public appreciation for the species and its readily identifiable characteristics. Information was gained primarily through a two-year publicity campaign which invited submission of photographic records from local land managers, fieldworkers and visitors to the study area. A total of 32 photo records were contributed, significantly adding to the small number of confirmed records in state databases, along with 47 records not accompanied by photographic evidence but deemed credible. A number of photo records were received from areas where the species had been sparsely or not previously recorded, as well as stony or range habitats previously considered to be non-optimal habitat. The north-eastern bioregions of South Australia accounted for the majority of recent records, where the Woma Python appears to remain a common inhabitant, yet the species appears absent or very sparsely distributed in other seemingly suitable or historic parts of its range.

INTRODUCTION

The Woma Python (*Aspidites ramsayi*) is a distinctive Australian endemic python which was formerly widespread within the arid sandy regions of inland Australia (Pearson, 1993; Maryan, 2002). This species is among the larger python species found in Australia and may reach up to 2.7 m in length and significant girth (Cogger, 1992). Within their range, the distribution of Womas appears to be relatively patchy and fragmented, with declines in some areas since European settlement. In the south-west of Western Australia the species has severely declined and now appears to be absent from most of its former range (Cogger *et al.*, 1993; Pearson, 1993; Maryan, 2002); in New South Wales it is rated as Vulnerable and considered to be in serious decline (Sadlier & Pressey, 1994; New South Wales Department for Environment and Conservation, 2010); and in Queensland its distribution appears to now be fragmented into at least two distinct populations, one of which is listed as Endangered (Covacevich & Couper, 1996). Suggested causes for these declines have included broad scale land clearing, changes in grazing pressure from rabbits and domestic stock and competition for food resources and predation of young individuals by cats and foxes; however there has been little or no targeted research to investigate or test these theories (Pearson, 1993; Covacevich & Couper, 1996; Maryan, 2002).

Within South Australia, Woma Pythons appear to have declined in some areas, particularly in the far northwest of the state (Robinson *et al.*, 2003), however their status and distribution in other arid areas is less clear and the species appears to be patchily distributed, although potentially locally common in some areas (Ehmann, 2005).

The study of pythons in the field is logistically constrained by their occurrence at low densities, patchy distribution and cryptic and nocturnal behaviour (Pearson, 1993). However, the Woma Python is a distinctive and readily identifiable snake species due to its characteristic banded patterning and the large size that mature individuals can reach. These features, combined with their docile nature make them a species that attracts considerable public interest within the Australian rangelands (Ehmann, 2005).

This study aimed to gain information regarding the current and historical distribution, status, significance of potential threats and habitat preferences of Woma Pythons by utilizing the public appreciation for this species and its readily identifiable characteristics to collect sightings and anecdotal accounts from across the South Australian rangelands.

METHODS

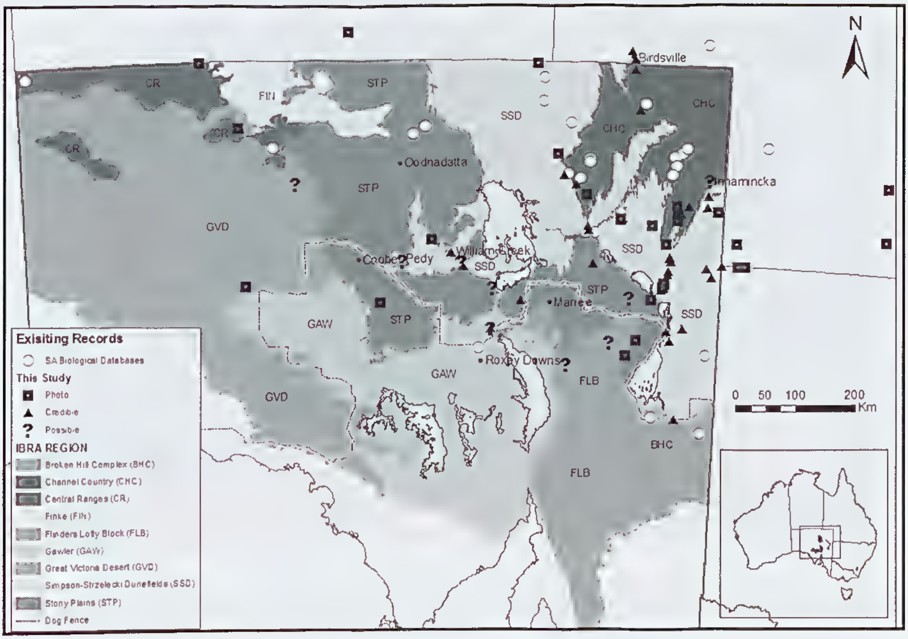
Information on the status and distribution of Woma Pythons was gathered through several means, including; a mail-out survey to pastoralists in the region, a publicity scheme involving incentives for submissions of verifiable sightings, gathering of anecdotal evidence by speaking to knowledgeable or longtime residents, land managers, workers or visitors about their perceptions of Woma distribution and status and a review of records in the South Australian Biological Databases and other published sources.

A mail-out survey containing an information sheet with photos and survey form was sent to 41 pastoral properties in the South Australian Arid Lands Natural Resources Management region in September 2007. The survey requested information on Woma Pythons from the property or surrounding regions and details about the date, location and basic habitat characteristics of sightings. Properties were selected within the known range of the species. Completed surveys were returned by 17 properties, ten of which reported sightings.

A publicity and reward for sightings scheme was initiated in mid 2009, through regional South Australian media. Posters and survey forms were displayed at regional pubs, roadhouses, mining and petroleum industry field stations and tourist visitor centres. Articles were placed in local newspapers and newsletters and a number of interviews received extended airplay on regional radio stations. The scheme requested any recent or past sightings of Woma Pythons to be submitted. Incentives to submit sightings were provided by issuing each verified sighting with a ticket in a draw to win one of five $100 fuel vouchers. To be eligible for the draw, sightings needed to be accompanied by a photo which verified the identity as a Woma Python along with detailed location and date details. Responses were received from over 100 people, many of whom had multiple sightings or anecdotes. A total of 34 verified records were gathered through this means, with a further 47 sightings believed to be Woma Pythons based on the description given including size (girth or thickness in particular), colour, behavior, the reliability and experience of the observer and the area and habitat of the sighting. A further nine sightings were deemed to be possible Woma records, while 20+ sightings were believed (or confirmed by photo) to be other snake species including Brown Snakes (*Pseudonaja* spp.), Mulga Snakes (*Pseudechis australis*), Carpet Pythons (*Morelia spilota*) and Stimson's Pythons (*Antaresia stimsoni*).

A range of other anecdotal accounts were gathered between 2007 – 2010 by speaking to pastoralists, long-time residents and workers in outback regions about their sightings and perceptions of the species over time. Database and published records were collated from a range of sources. Sightings and records were considered within the various IBRA Regions (Interim Biogeographic Regionalisations of Australia) of the state (Figure 1).

Figure 1. Woma Python records from northern South Australia and neighbouring areas of Queensland and Northern Territory, showing existing database records (from South Australian Biological Survey Database) and those compiled through this study.



RESULTS

Channel Country

A total of 28 sightings was received during this study from the Channel Country bioregion, mainly from around the Moomba and Innamincka areas where observers associated with oil and gas extraction from the Cooper Basin were numerous (Figure 2). Respondents living or working in those areas were very familiar with Woma Pythons and reported seeing them regularly, particularly during the warmer months of the year. Many of the sightings were made late at night or during the early hours of the morning by shift workers and individuals of a range of sizes were reported. Many respondents described regularly observing large individuals, sometimes with distinctive scars or markings over extended periods and believed them to be resident near the sighting locations. Records held in the South Australian Biological Survey Database included several Womas captured in excavated trenches as part of construction of oil and gas pipelines in the Cooper Basin (Owens, 1998). Historic accounts also describe the species from these areas (Vogelsang, 1938).

A number of sightings were contributed from along the Birdsville Track, including around Mungerannie and the Naterannie Sandhills to the north of Cooper Creek. Recent database records exist of the species on Cowarie Station and several sightings were reported in the far north of the Birdsville Track from Clifton Hills and Pandie Pandie Stations and near Birdsville.

Perceptions of the status of Woma Pythons in the area were variable, with most residents or field workers interviewed regarding them as common around the upper Strzelecki Track and perhaps less so along the Birdsville Track. One long-time resident of Birdsville com-

Figure 2. A large Woma from the Strzelecki Desert Dunefields near Moomba, March 2010 showing indistinct banded patterning typical of the species in this area (sighting CHC15). Photo: Paul Waring.

Figure 3. A Woma Python found in cracking clay stony plain habitat near the Beverley Uranium Mine, to the north-east of the Flinders Ranges in May 2010 (sighting STP05) Photo: David Hunt.

Figure 4. A dark and distinctly banded Woma Python near IGY Corner, Mobella Station (near the south-west corner of Tallaringa Conservation Park), May 2009 (sighting GVD02). This photo represents the only confirmed record in the Great Victoria Desert Bioregion from this study. Photo: Andy Searle.

Figure 5. A Woma Python encountered on the Stuart Highway 90 km S of Coober Pedy at night in March 2004. The very dark colouration of the snake and the rocky habitat, including quartzite boulders, are of note (sighting STP06). Photo: Dave Harnett.

mented that he remembered there being a lot more Woma Pythons around when he was younger, particularly before the huge floods of 1974 when he suspected that many had been drowned. Other anecdotes suggested that the species had become isolated on islands during major floods of large inland rivers, particularly in the 1970s and a contemporary observation during the study involved a dead Woma deposited in flood debris high in a tree overhanging the Warburton River channel in May 2010 (CHC26).

Simpson/Strzelecki Dunefields Bioregion

A total of 35 observations was received from sandy habitats of the Simpson/Strzelecki Dunefields Biogregion. The majority from this bioregion came from along the Strzelecki Track, particularly the Cobbler Sandhills area around Montecollina Bore and areas to the immediate north. Residents and regular travellers and visitors to this area regarded Womas as a common inhabitant. One long time resident from between Merty Merty and Moomba reported knowing the breeding location of the species and remembered seeing small Woma Pythons in most years. Another from east of Lake Frome also reputedly knew the breeding locations of Womas in sand dune areas.

In the dune field areas of the south east of the bioregion near Cameron Corner and areas to the south, pastoralists who were interviewed regarded Woma Pythons as a common inhabitant which they saw regularly and sometimes near sheds and station buildings. Historic accounts from the 1930s also support that the species was a reasonably common inhabitant in the dunefields to the east of Lake Frome (White, 1962).

At the far south-western extreme of the bioregion, near Lake Eyre South and between William Creek and Coober Pedy, there are a few confirmed records of Woma Pythons and the species is regarded with fabled status amongst life-long locals, many of whom have never observed them despite decades spent outdoors during station activities. A museum specimen collected in 2002 as road-kill in dune fields 30 km south-east of William Creek, and a further three credible sightings (SSD31, SSD34, SSD35) and one possible sighting (SSD14) were contributed through this study and support the presence of the species at this location. These sightings described extremely large faintly banded pythons and all were within five kilometres of the 2002 roadkill specimen in an area of isolated large sand dunes.

Flinders-Lofty Block Bioregion

Several possible sightings were reported from the Northern Flinders Ranges, which is an area not necessarily regarded as Woma habitat due to the primarily hilly and stony terrain. An informant who was very familiar with the species from the sandhills of the Strzelecki Desert knew of Woma Pythons from the vastly different range country around Umberatana Station and reported seeing a large one there as recently as mid 2009 on a slaty hill (FLB03). He was also familiar with the species from other locations in the Flinders Ranges around Yerelina and Angepena Stations. Other anecdotal reports from the Flinders Ranges of a large snakes that resembled Womas included a large, thick python seen in a backyard on the outskirts of Leigh Creek in 1989 (FLB02).

Woma Pythons were not recorded during the biological surveys of the North West Flinders Ranges in the 1990s (Brandle 1998a), however anecdotal reports were received of a small road-killed python resembling a Stimson's Python (*A. stimsoni*) and separate reports of large pythons inhabiting red gum creek lines came from landholders at Burr Well and Puttapa Stations, which were considered by the authors to be Carpet Pythons (*M. spilota*) (Brandle, 1998a). There is a strong possibility that the pythons reported from the area during this study were in fact Carpet Pythons, especially given other anecdotal reports gathered through this study of a large Carpet Python which was run over on the Copley to Balcanoona road near the

Depot Springs homestead in the 1990s. However, it is possible that Woma Pythons also may be found in some areas of the Northern Flinders Ranges.

A record confirmed by photos from the eastern edge of the bioregion at Wooltana Station Homestead in March 2008 included a 2.5 m Woma Python which was found moving across the verandah of the homestead after a shower of rain on a hot day (FLB01). Discussions with this observer and other long-time local residents suggest that this species was not well known from the local area, but that Stimson's and Carpet Pythons were known from rocky hills nearby.

Stony Plains Bioregion

Nine sightings were gathered from this bioregion, including four verified with photos. These included a large Woma Python from the Beverley Uranium Mine in April 2010 (STP05) (Figure 3). The habitat in this area consists of open gibber country and is quite unlike the adjacent areas in the Simpson-Strzelecki Dunefields on the eastern side of Lake Callabonna and Lake Frome which are known to support the species. Other verified records included a dark-coloured Woma photographed at night, 90 km south of Coober Pedy on the Stuart Highway in stony plains country in 2004 (Figure 4), a ~3 m individual photographed on the Oodnadatta Track in late 2011 on gibber flats approximately 45 km north-west of William Creek (STP08) and a credible sighting of a large Woma in vast stony plains habitat at Alberrie Creek, halfway between William Creek and Marree (STP09).

Perceptions of residents in this bioregion suggest that Woma Pythons are rarely encountered in these areas, despite many knowing the species from sandy habitats. Some museum specimens from the northern parts of the bioregion near Oodnadatta from the late 1990s (Figure 1) come from the Oolganna Sandhills on Macumba Station which fringe the extensive dunefields of the Simpson Desert and thus are not truly stony habitats.

Broken Hill Complex

Only one credible Woma observation was contributed from this fringe of this bioregion, on the southern edge of the extensive Simpson-Strzelecki dunefields on the Dog Fence (BHC01), but some database and museum records exist from this area. These include a 2 m specimen held in the South Australian Museum which was found dead in the Dog Fence on the Erudina/Frome Downs boundary and another enormous >3 m specimen found dead and photographed on the road in sand plain country in central southern Mulyungarie Station.

Gawler

Although there are very few confirmed records of the species from this area, some potential sightings were gathered through the study. A suspected Woma Python was seen by a station worker who was familiar with the species from the Simpson-Strzelecki Bioregion in the early morning in November 2003 as it crossed the Borefield Road approximately 60 km north of Roxby Downs in the dunefields of the locality known as Canegrass (GAW01). Another observer also recounted being present during the capture of a large Woma from a rabbit warren in the dunefields at Canegrass during the early 1980s (GAW02).

A large Woma Python was also found dead on the roadside at Olympic Dam township in 1990. Aside from some historical accounts from station workers of the species inhabiting the Roxby Downs region during the 1930s (Read, 2003), this is the only contemporary specimen collected from the biogregion. The paucity of records from the area, especially given the extensive faunal surveys and monitoring associated with the Olympic Dam mine over the last 25 years (Brandle, 1998b; Read & Owens, 1999), led those who discovered the road-kill specimen to suspect that it possibly was collected elsewhere and then left there for some unknown reason; however the chance of it being a local animal cannot be ruled out.

Great Victoria Desert

Just two sightings were received from this region, including a photo of a dark and well banded Woma from the far north-western corner of Mobella Station in the southern Great Victoria Desert (GVD02) (Figure 4). A possible sighting included an observation of a huge snake in sandhill country near the Wintinna Station/Tallaringa Conservation Park boundary in the far east of the bioregion in the late 1980s (GVD01). Other anecdotal accounts included descriptions of Woma Pythons being hunted and regarded as a delicacy around Oak Valley, however these credible anecdotes from the area not accompanied by any published or database records.

Finke

One Woma Python record was obtained from this region during the study and consisted of photos of aboriginal people (Anangu) from Ernabella holding a mature Woma which had reportedly been captured near Finke in 1991 (FIN01).

Central Ranges

Three confirmed records were submitted from this bioregion in the northern Anangu-Pitjantjatjara-Yankunytjatjara (APY) Lands, including photographs of a large, dark banded individual captured near Mimili in November 2010 (CR01) and photographs of two other individuals from near Eagle Bore north of Ernabella on the Northern Territory Border taken in 1995 and 1999 (CR02, CR03). A specimen held in the Western Australian Museum was collected in the 1950s from Pipalyatjara (Mt Davies) in the far north-western corner of South Australia (Pearson, 1993).

The biological surveys of the APY Lands did not result in any confirmed records of the species, although tracks of one were reported from around Lake Wilson at the western end of the Mann Ranges and an account of one being caught at Fregon and given to a liaison officer in mid 1990s was provided (Robinson *et al.*, 2003). Anecdotal information collected from Anangu as part of the surveys suggested perceptions were that the species was once common around Amata and Ernabella within living memory but was no longer seen there (Robinson *et al.*, 2003). Discussions with Anangu and others who visit or work in these areas during this study suggest that Womas are an uncommonly observed animal in these areas and are a prized delicacy when encountered.

DISCUSSION

Status and distribution

Confirmed records, anecdotes and observations of Woma Pythons collected through this study suggest that the species is a common inhabitant of parts of the arid north-east of South Australia, but less common or even absent from large expanses of apparently suitable habitat. A large number of recent records of mature Womas as well as some medium sized and juvenile individuals were reported from the Channel Country and Simpson-Strzelecki Dunefield Bioregions and these areas appear to be the stronghold of the species within South Australia. Presumably populations in these areas are continuous with those in neighbouring states, although there are very few records from New South Wales and the species is considered to be found only in the north-western extremity of that state (Sadlier & Pressey, 1994).

The large number of recent sightings from the Channel Country and Simpson-Strzelecki Dunefield Bioregions, particularly in the Cooper Basin petroleum fields, are likely to partly reflect the comparatively large number of observers who frequent the area through this industry. However, the presence of the species in these areas, yet apparent absence in other areas of seemingly similar suitable habitat where there are also many observers is somewhat puzzling. Areas such as the dunefields of the northern Gawler Bioregion, which have undergone significant faunal survey works and have large numbers of field workers associated with the Olympic Dam Mine, as well as parts of the Finke Bioregion such as the Pedirka Desert in the central far north of the state appear to provide suitable habitat, yet there are very few records from these areas. The species distribution prior to European settlement in these regions is not

well understood and it is possible that there has been some decline due to changes in land management and the introduction of feral species.

Declines and possible threats

Despite the suggestion that various factors including habitat modification from land clearing and grazing (Covacevich & Couper, 1996; Maryan, 2002) and predation and competition from cats and foxes (Pearson, 1993; Read *et al.*, 2011) may be responsible for the decline of Womas in other parts of Australia, there is very little detailed information on the relative importance of these factors.

The paucity of Woma Python records from areas south of the dog fence in South Australia is also of interest, especially in light of accounts that suggest the species was historically present in at least some of these areas (Read, 2003). The apparent absence and probable decline of Womas inside the dog fence may indeed be related to factors such as those which are thought to have affected the species in other parts of Australia. Foxes and cats are generally more common inside the dog fence in the absence of dingoes (Newsome *et al.*, 2001; Letnic *et al.*, 2009) and may be important predators of young Womas and also potential competitors through their predation of other small mammal and reptile species (Read & Bowen, 2001). Areas inside the dog fence have also possibly suffered greater habitat modification through historically higher grazing impacts from sheep versus cattle in many areas outside (Newsome *et al.*, 2001).

The reasons for the apparent declines in the species in the western parts of the state, particularly in the APY lands are not known. There is a possibility that these may be related to changes in hunting pressure from Anangu as a result of visitation to known Woma collection sites being made more accessible or regular by the use of motor vehicles. The relatively low number of sightings reported during this study from the APY lands is likely to be related to the methods used in collecting sightings rather than the absence of the species. Publicity and survey effort focused mainly on areas to the east of the APY lands due to logistical constraints and the nature of communication mediums and publicity opportunities was generally better tailored to the residents and visitors to these areas.

Several of the observations of Womas reported in this study were of those that had been killed on the road (CHC07, CHC16, SSD05 and SSD10) and in some areas of high traffic, this may be an important threat especially if populations are already fragmented or recruitment is being affected by other factors. The influence of catastrophic flooding events was also raised by several observers and one observation supports that flooding kills some Womas (CHC26). The impact of man-made barriers such as the dog fence and electrified sections in particular were also raised as a possible cause of Woma mortality (SSD04). Some recent data from trial reintroductions of captive-bred Womas into the Arid Recovery reserve at Roxby Downs have also has highlighted Mulga Snakes (*P. australis*) as potential predators of wild Woma Pythons (Read *et al.*, 2011). All nine Womas released into this feral free reserve were killed within four months, with Mulga Snake predation confirmed or implied in all cases. Although these predation events may be an artifact of the captive-bred individuals and their introduction into established elapid territories, it raises the possibility that Mulga Snakes may have a role in regulating Woma populations under some circumstances (Read *et al.*, 2011).

Habitat

Many sources describe sand plains and sand dunes as the primary habitat for Woma Pythons (Cogger, 1992, 1993; Covacevich & Couper, 1996; Ehmann, 2005). Yet several confirmed records collected through this study were from non-sandy areas. These include the two recent records from the Beverley Mine (STP05) and Wooltana Station (FLB01) on the western side of Lake Frome. These sites support cracking clay gibber plains and abut dune fields of the Simpson-Strzelecki Biore-

gion to the east and the Flinders Ranges to the west. Both records were from mid autumn, around the time when Womas have been recorded mating in captivity (Stone, 2010; Read *et al.*, 2011) and could possibly be males wandering from their normal territories in search of a mate. Additional confirmed records from stony plains habitat include a Woma Python photographed at night south of Coober Pedy (STP06) near rocky outcrop areas surrounded by stony plains and another north of William Creek in gibber habitat (STP08). In the case of both of these sightings, the nearest sand dune areas are many kilometres distant.

In other parts of Australia Woma Pythons also occur in some non-sandy habitat. In Western Australia the species is known to occur primarily in sandy habitats, but can't be precluded from occurring in rocky areas (Maryan, 2002). Records and aboriginal knowledge of the species from around Uluru, Northern Territory suggest that the species prefers Spinifex sandplain, but not rocky areas (Reid *et al.*, 1993; Baker *et al.*, 1993). In Queensland Woma Pythons occur in sandy as well as non-sandy habitats, including the desert and semi desert grasslands and chenopod woodlands on red sandy soils and stony downs of the Channel Country Complex and the black soils and ridge country in the Brigalow woodland and grasslands of the Brigalow Biogeographic region to the east (Covacevich & Couper, 1996).

It has been suggested that Woma habitat preferences may be more complex than sandy versus non sandy habitats *per se* and may actually correlate with food and shelter resources (Covacevich & Couper, 1996). Woma Pythons are known in parts of Queensland as the 'Bilby Snake' and are thought to have utilised Bilbies as food items and their burrows as shelter sites (Covacevich & Couper, 1996). Greater Bilbies (*Macrotis lagotis*), Burrowing Bettongs (*Bettongia lesueur*) and other medium-sized mammals in the so called Critical Weight Range (Burbidge & McKenzie, 1989) once dominated many parts of arid South Australia but suffered widespread extinction, with rabbits replacing them as the only similar sized mammal (Johnson, 2006). Burrowing Bettongs were known to occupy sandy as well as non-sandy habitats (Short & Turner, 1993; Finlayson & Moseby, 2004) and their large warren complexes can still be seen in a range of harder soil types where they are now inhabited by rabbits (Noble *et al.*, 2007). These warrens are still effectively functioning as good Woma shelter sites, with rabbits replacing bettongs as a similar sized mammalian food item. As Covacevich and Couper (1996) suggest, Woma distribution may not comprise just sandy country, but rather areas suitable for small burrowing mammals such as the Bilby. In arid South Australia this theory would also extend to species such as the Burrowing Bettong and following the major mammalian extinctions of Australia's rangelands, which have eliminated these species, this also includes rabbits. The stony plains and range country where records or anecdotes of Woma Pythons were reported during this study all include areas suitable for rabbits and rabbit warrens.

CONCLUSIONS

The large number of sightings and anecdotes collected through this survey have added significantly to the distributional information held within published literature and databases for this species in South Australia and suggest that Woma Pythons remains a relatively common inhabitant of the arid rangelands of the state, particularly the sandy regions of the Simpson-Strzelecki Dunefields and the Channel Country Bioregions. Records from the fringes of these regions, areas of stony or range country and western bioregions such as the Great Victoria Desert and Central Ranges Bioregions are much less common and observations gathered through this study provide a basis for further, more detailed investigations in these areas. The methods used during this study to collect information on this iconic, yet poorly understood species highlight the value of harnessing community knowledge and opportunities

for observation in biological research, particularly for species which are difficult to survey through conventional scientific methods.

Despite this increase in the distributional data for Woma Pythons, detailed information on important aspects of the life ecology of this species are still lacking. The absence of suitable information on diet, breeding behaviour, survivorship of young and the importance of predation by introduced species such as cats and foxes needs to be addressed in order to better determine the species status and threats.

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APPENDIX

Sighting number refers to IBRA region labels shown in Figure 1. Sighting reliability: **Verified** - sightings verified with photographic evidence; **Credible** - confirmed based on the experience and reliability of the observer and the accompanying evidence and description given; **Possible** - not attributable as womas with confidence based on the location of the sighting or the evidence and description provided.

Verified Sightings

Sighting #	Date	Latitude	Longitude	Location	Comments
CR01	24 Nov 2010	-27.0089	132.7111	Mimili, SA	
CR02	1999	-26.0114	132.0936	near Eagle Bore Homeland, APY Lands (near SA/NT border approx. 30 km NNW of Ernabella)	
CR03	1995	-26.0114	132.0936	near Eagle Bore Homeland, APY Lands (near SA/NT border approx. 30 km NNW of Ernabella)	
CHC01	26 Mar 2009	-28.7059	140.0461	approx. 50 km S of Moomba on Moomba-Adelaide Gas Pipeline - Compressor Station 1	Approx 2.5 m long. Under transportable building for three days.
CHC08	2 Feb 2007	-28.3442	140.2217	30 km S of Moomba on Strzelecki Track	Midnight. ~1.8 m long and in good condition.
CHC09	30 Apr 2009	-28.7059	140.0461	approx. 50 km S of Moomba on Moomba-Adelaide Gas Pipeline - Compressor Station 1	~2.5 m. Lay in same spot for a week under building.
CHC10	3 Feb 2010	-28.7059	140.0461	approx. 50 km S of Moomba on Moomba-Adelaide Gas Pipeline - Compressor Station 1	~ 1.5 m. Had black flecked scales - maybe injury. 100 mm rain fell in 24 hours prior to sighting.
CHC11	29 Jan 2010	-28.1161	140.2067	Moomba Operations - Process Plant	In very poor condition, incomplete slough, heavily scarred & large tick infestation. - 2.2 m long.

CHC15	20 Mar 2010	-28.1161	140.2067	Moomba Operations - Process Plant	1.8 m long. Had heavy tick infestation.
CHC22	31 Jan 2010	-28.2413	140.273	Mungerannie Roadhouse, Birdsville Track	~2.1 m. Behind roadhouse, sheltering under house. Very placid.
CHC28	Dec 2010	-28.0081	138.6575	Mungerannie Roadhouse, Birdsville Track	
FIN01	1991	-25.5757	134.5883	near Finke, NT	Captured near Finke. Photos taken at Ernabella.
FLB01	Mar 2008	-30.4144	139.4244	Wooltana Station Homestead	Big snake - released in ranges nearby unharmed.
GVD02	1 May 2009	-29.3894	132.7963	near IGY Corner, Mobella Station (near SW corner of Tallaringa CP)	Large distinctly banded python.
QLD01	29 May 2008	-28.4878	143.8243	Dingo Barrier Fence, Zenonie Station, Qld	~2.1 m long and very fat and placid. In sandy mulga country. Only one seen in 30 years of residency.
QLD02	18 Nov 2008	-27.6843	143.7789	South of Glenmorgan, Qld	Only one ever seen at property.
QLD04	18 May 2010	-28.6585	141.2577	10 km N of Ormicron on road to Epsilon (north-east of Cameron's Corner)	~2.2 m long: Very large and fat. Basking on road mid-morning in sunny conditions.
SSD02	3 Oct 1997	-26.0243	137.7654	~20 km W of Poeppel Corner, on French Line, Simpson Desert CP	Almost 2 m. Conditions cool with early morning showers.
SSD07	20 Oct 2009	-29.2981	140.0371	10 km N of Montecollina Bore on Strzelecki Track	Basking on road - slow to move whe chased off on foot. Weather cool.
SSD09	13 May 2010	-27.3886	138.1483	Just north of Kallakoopah Creek in sandhill country on northern side of Cowarie/Simpson Desert NP boundary	Observed from helicopter when flying very low (80 ft) in early morning. Could see tracks where it had emerged from rabbit warren and was sunning itself. Very dark colour, approx. 2 m long.

SSD11	23 May 2010	-28.1980	140.9136	Near Dilchee Gas Field, south of Dullingari	Seen in middle of road at approx. 11am.
SSD18	10 Jul 2010	-28.2615	140.2317	100 km S of Innamincka on Strzelecki Track	Observed on road.
SSD20	1 Mar 2010	-29.3546	140.0227	5 km N of Montecollina, Strzelecki Track	Captured on road.
SSD21	1 Mar 2010	-29.3047	140.0365	10 km N of Montecollina, Strzelecki Track	~1.3 m long.
SSD22	1 Jan 2000	-28.3513	139.2478	Lake Hope area, Cooper Creek	
SSD29	8 Jun 2010	-29.0013	141.4224	~50 km E of Cameron's Corner on Qld/NSW border	
SSD30	4 Apr 2011	-29.0017	141.2932	28 km E of Cameron's Corner on Qld/NSW border	
SSD32	1 Apr 2006	-28.4277	139.8020	~10 km from Worrier Oilfield (~70 km SW of Moomba)	Observed crossing road during day.
STP05	15 Apr 2010	-30.1718	139.5877	Beverley Uranium Mine	Found crossing road in late afternoon ~5:30 pm. > 2m long.
STP06	1 Apr 2004	-29.6700	135.1353	90 km S of Coober Pedy on Stuart Highway	Seen crossing road at night near rocky outcrop. Dark colour with distinct bands.
STP07	5 Apr 2011	-29.5477	139.8344	Strzelecki Track, approx. 10 km N of Mt Hopeless turnoff	
STP08	Dec 2011	-28.7235	136.0105	Oodnadatta Track near Anna Creek/Nilpinna Station boundary, approx. 45 km N of William Creek	>2.5 m long. In gibber country a long way from sand dunes.

Credible sightings

Sighting #	Date	Latitude	Longitude	Location	Comments
BHC01	2009	-31.337	140.3158	Dog Fence, on boundary of Billeroo West/ Quinyambie Leases	~1 m long with distinct brown and yellow bands. Went through fence when approached.
CHC02	26 Oct 2009	-28.103	140.1995	Moomba Airport	1.1 m. Seen on road at 1:00 am. 25° C, no wind.
CHC03	26 Nov 2009	-28.1161	140.2067	Moomba Operations - Camp Facility	1 m. Had scar midway along left hand side.
CHC04	30 Oct 2009	-28.1161	140.2067	Moomba Operations - Process Plant	0.5 m, 3:00 am. In good health and very lively - a few small scars. Calm, warm night, no wind.
CHC05	26 Nov 2009	-28.1161	140.2067	Moomba Operations - Process Plant	Humid - approx 31° C
CHC06	23 Nov 2009	-28.1161	140.2067	Moomba Operations - Camp Facility	1.1 m long. Sheltering under temporary cool rooms. Hot and windy conditions - 5:00 am.
CHC07	1 Feb 2006	-28.0185	138.6603	Big Lake Oilfield, Moomba	Under building.
CHC12	16 Jan 2010	-28.1584	140.2109	6 km S of Moomba	~1 m long with central spine stripe and rib stripes. Was crossing road 6:20 am in predawn, approx 28° C.
CHC13	1 Jan 2008	-28.1074	140.2068	Moomba Operations - Camp Facility	~ 2.4 m. Approx 5 am on very warm morning ~30° C.
CHC14	17 Mar 2010	-28.103	140.1995	Moomba Airstrip	~ 2 m long. Moving across tarmac on airstrip at night - warm night, clear skies.

CHC16	22 May 2010	-27.9669	140.7286	25 km S of Innamincka on Strzelecki Track	Crossing road at about 11 am. Wound the size of 10c piece behind head.
CHC17	2 May 2010	-28.1836	140.2151	10 km S of Moomba on Strzelecki Track	~1.8 m long.
CHC18	22 Apr 2010	-28.1363	140.7222	Dullingari Road, 2 km E of Innamincka turnoff	~2.3 m. Heavy tick infestation. Observed on road.
CHC19	12 Dec 1989	-26.6887	139.5074	Koonchera Waterhole, Goyder's Lagoon	~1.5 m. Seen at dusk moving between bushes on sand near water. Rabbit warrens nearby. ~42° C
CHC20	1 Mar 2007	-28.2413	140.273	Mungerannie Roadhouse, Birdsville Track	Seen at roadhouse in evening.
CHC21	2006	-27.8526	138.477	Cowarie Station boundary on Cowarie/ Mungerannie Road	
CHC23	1995	-28.3857	139.2435	Lake Hope area, Mulka Station	Seen disappearing into a rabbit burrow.
CHC24	Jan 2000	-26.0764	139.3956	5 km N of turnoff to Pandie Pandie Station Homestead, Birdsville Track	
CHC25	Dec 2007	-29.0541	140.7593	Innamincka Station	
CHC26	May 2010	-27.7089	138.2591	Warburton River, near Kalamurina Homestead	Observed hanging dead in a tree with other debris following flooding in early 2010.
CHC27	11 May 2011	-25.9179	139.3939	6 km E of Birdsville on road to Betoota	
GAW02	~1984	-30.0715	137.0583	55 km N of Roxby Downs on Borefield Road near Canegrass Dam	
QLD03	1 Jan2005	-25.7944	139.3275	10 km N of Birdsville	On gibber flat.
SSD01	12 May 2009	-29.2981	140.0371	10 km N of Montecollina Bore on Strzelecki Track	Moving across road.

SSD03	2005	-29.1541	140.0949	Bob's Bore, Strzelecki Track	Hatchling womas around camp in Aug/Sept each year - last time in 2005.
SSD04	1 May 2009	-30.0232	140.1084	Dog Fence, on Moolawatana/Lake Frome boundary	~2.7 m. Found dead next to electric section of Dog Fence - presumably electrocuted.
SSD05	3 May 1987	-28.8978	140.1132	North side of Cobbler Sandhills, Strzelecki Track	2.5 m. Freshly dead roadkill.
SSD06	4 Mar 1991	-29.9735	140.3844	Yandama Bore, Frome Downs Station	2.75 m long and 10 cm diameter. Near water pooling from bore in Yandama Creek. Went down rabbit burrow. ~11pm, 30° C.
SSD08	1 Dec 2009	-29.3534	140.0229	8 km N of Montecollina Bore, Strzelecki Track	Found eating rabbit in a burrow.
SSD10	15 Apr 2010	-28.9658	140.1295	approx. 3 km S of Strzelecki Crossing, Strzelecki Track	1.8 m long and 10 cm diameter. Found dead on road. Mustard yellow under belly and dark bands.
SSD12	2002	-28.543	138.71	Mulka/Etadunna Station boundary at grid on Birdsville Track	
SSD13	1995	-28.4855	138.6903	Birdsville Track - in Naterannie Sandhills	
SSD15	1 Jun 2008	-29.1868	140.8496	Lindon Station Homestead	Young animal.
SSD17	25 Apr 1991	-29.1085	140.105	Strzelecki Track, 18 km S of Strzelecki Crossing	2.5 m. Observed basking on pale canegrass dune at midday. Adult male. Ambient temp; ~ 20° C.
SSD19	Jan 1982	-30.1711	140.1684	approx. 10 km E of Lake Frome (5 km S of track from Hawker Gate to Moolawatana), Frome Downs Station	
SSD23	23 Sep 2010	-29.0048	141.0131	approx. 1 km E of Cameron's Corner	
SSD24	4 Oct 2010	-29.401	139.9867	near Montecollina Bore, Strzelecki Track	

SSD25	29 Mar 2011	-29.3682	140.0165	~5 km N of Montecollina Bore on Strzelecki Track	
SSD26	29 Mar 2011	-28.9108	140.1143	~5 km N of Strzelecki Crossing on Strzelecki Track	
SSD27	29 Mar 2011	-28.1235	140.4148	~20 km E of Moomba on Innamincka Road	
SSD31	20 Apr 2011	-20.0199	136.4860	~20 km SE of William Creek on Oodnadatta Track	
SSD33	21 Mar 2011	-28.1161	140.206	Moomba Operations - Camp Facility	
SSD34	15 May 2009	-29.0653	136.522	~30 km SE of William Creek on Oodnadatta Track	
SSD35	11 May 2011	-29.1229	136.5554	~5 km W of Warriner Creek (~33 km E of William Creek) on Oodnadatta Track	
STP02	~1975	-28.9082	136.3416	William Creek township	Big snake crossing road on summer evening.
STP04	~1995	-29.0441	138.7886	Cooryninna Creek, NE of Dulkaninna Station Homestead	
STP09	24 Oct 2011	-29.6274	137.5604	Alberrie Creek on Oodnadatta Track	Big pale banded python on thundery day.

Possible sightings

Sighting #	Date	Latitude	Longitude	Location	Comments
FLB02	1989	-30.5949	138.3922	Leigh Creek township	2.4 m and thicker than arm. Hilly habitat.
FLB03	Jun 2008	-30.2478	139.1265	Umberatana Station	Has frequently seen womas at this location.
GAW01	13 Oct 2003	-30.0785	137.0537	near Canegrass Dam, Borefield Road, approx. 60 km N of Roxby Downs	Seen crossing road 7:30 am. Observer familiar with womas from elsewhere.

GVD01	1987	-27.8711	133.6789	Manya Bore, near boundary of Tallaringa Conservation Park and Wintinna Station	Huge snake crossing track. Mulga scrub on sand dunes.
SSD14	2005	-29.0653	136.522	30 km S of William Creek	In sandhill country.
SSD16	1975	-29.0533	135.5092	Balta Baltana Creek, between Coober Pedy and William Creek	Found huge sloughed snake skin in rabbit warren - could not attribute this to any other species.
SSD28	3 Apr 2011	-27.7433	140.7485	Innamincka Airstrip	
STP01	17 Mar 2010	-29.5587	139.4465	150 km N of Lyndhurst on Strzelecki Track (near Blanchewater)	<1 m. ID not certain.
STP03	~1977	-29.4635	137.0749	Curdimurka Railway Bridge	Seen crossing tracks while driving train at night. Large enough to be mistaken for a sleeper obstructing tracks (hit emergency brake).

REASSESSMENT OF THE REPTILES IN KEVERSTONE NATIONAL PARK ON THE CENTRAL TABLELANDS OF NEW SOUTH WALES

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ABSTRACT

A census of reptiles was undertaken in Keverstone National Park on the central tablelands of New South Wales. Seventeen 0.5 hectare plots (50 x 100 m) were surveyed for 60 minutes each within the two sections of reserve. The plots covered a range of vegetation communities and were located, mostly along ridgelines, at altitudes that ranged from 640-880 m AHD. A total of 14 species of reptile was observed. An additional species, the Jacky Dragon *Amphibolurus muricatus* was detected opportunistically. The Nobbi Dragon *Amphibolurus nobbi*, Lace Monitor *Varanus varius* and Bearded Dragon *Pogona barbata* have previously been observed in the reserve. The Inland Wall Skink *Cryptoblepharus australis* was observed in one small area and represents a range extension for this species.

INTRODUCTION

In 1998 surveys were conducted for reptiles and amphibians in Razorback Nature Reserve (NR) and Keverstone State Forest as part of the southern Comprehensive Regional Assessment (CRA) (Daly *et al.*, 2001). At that time two sites in Keverstone State Forest were surveyed systematically using methods developed for the assessment of fauna for the comprehensive regional assessment in New South Wales (NPWS, 1998). We recommended that Keverstone State Forest be added to the reservation system as native vegetation in the surrounding area had been mostly cleared for agriculture and the state forest provided habitats not represented in Razorback NR. Keverstone National Park is currently managed under section 159 of the National Parks and Wildlife Act (1974) as part 11 land. The park covers two portions of land, Keverstone West (1007 hectares) and Keverstone East (2020 hectares).

This paper presents additional information on the species of reptile in Keverstone National Park (NP) using methods developed as part of the CRA process. The data augments other studies conducted by the senior author in the region (Daly *et al.*, 2001) to provide additional information on the region's herpetofauna.

METHODS

Study area

Keverstone NP (34°08'S 149°16'E) is located on the central highlands of New South Wales approximately 40 km north-west of Crookwell. The climate is cool to mild with temperatures influenced by the regions elevation of 600–920 m AHD. The average minimum and maximum temperatures range between 5–18° C. The climate data for Crookwell indicates that the average annual rainfall for the region is 850 mm occurring mostly in winter. Keverstone NP currently consists of two portions of land separated by a distance of approximately two kilometres. The separate portions are herein referred to as Keverstone East and West. The total area reserved is 3027 hectares (Figure 1) and contains the upper tributaries of Meglo and Blackmans Creeks, which flow into the Abercrombie River.

Geology and soil

Keverstone NP is characterised by high rolling hills and undulating ridges dissected by valleys and steep gullies. The geology varies between the two sections of the Park. In Keverstone East the substrate is eroded metamor-

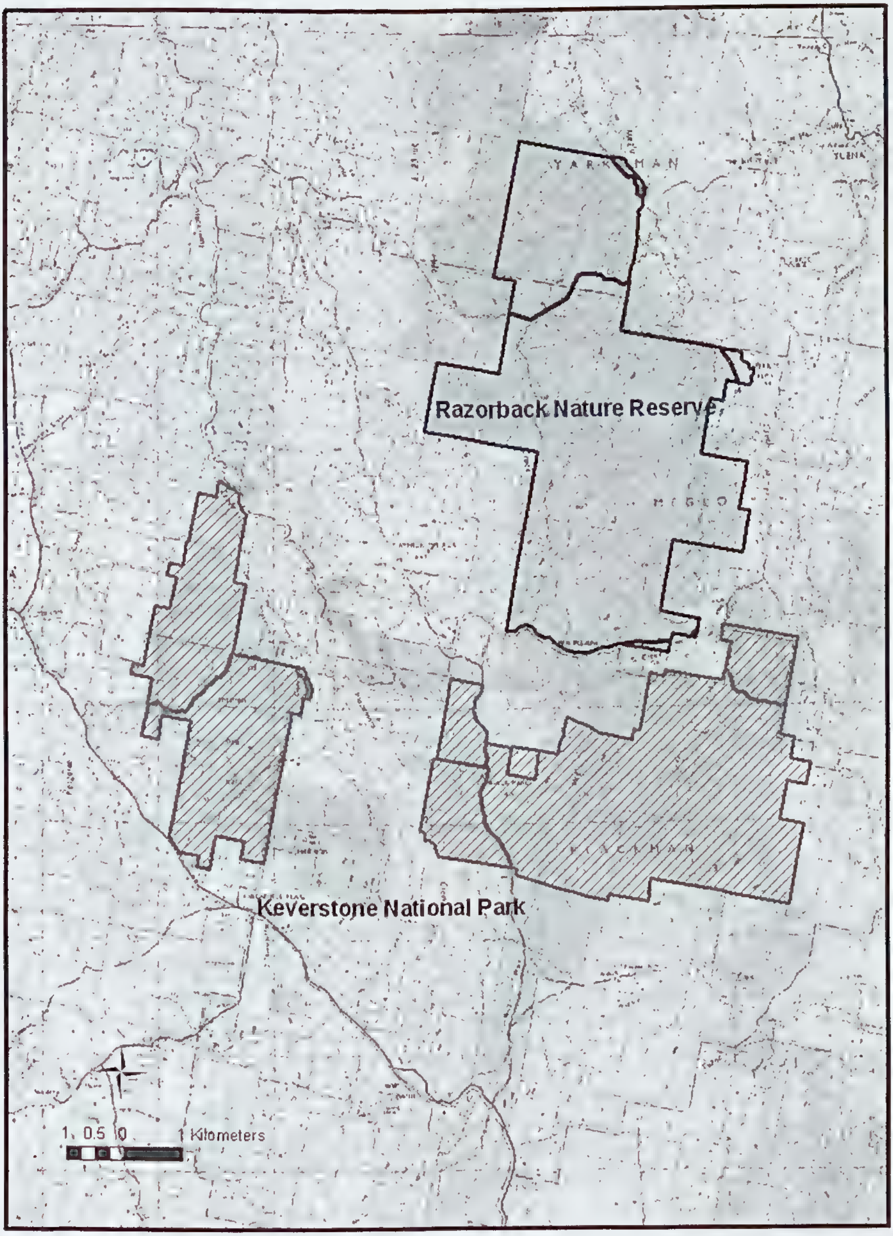
Table 1. Location of systematic survey sites, survey effort and description of vegetation

Key: E = Keverstone East, W = Keverstone West, G = gully, R = ridge, M = midridge.

Grid references in AMG 66 datum. Eastings and Northings in ADG Zone 56. Altitude (Alt) in metres AHD. Site WR4 was previously surveyed in 1998 and referred to as site 84 by Daly *et al.* (2001).

Site	Easting	Northing	Alt	Survey effort	Vegetation
EG1	709432	6223653	700	1435–1505 on 16.iii.09	*Eucalyptus goniocalyx*
EG2	709450	6223890	760	1356–1426 on 18.iii.09	Not recorded
EG3	711985	6221482	880	953–1023 on 18.iii.09	Not recorded
EG4	706720	6223040	760	1022–1052 on 19.iii.09	Highly disturbed *Poa* grassland
EM1	706910	6222750	800	1110–1140 on 19.iii.09	*Eucalyptus rossii*
ER1	709694	6220872	880	1227–1257 on 16.iii.09	*Eucalyptus rossii*
ER2	710090	6221977	860	1319–1349 on 16.iii.09	*E. goniocalyx* and *Eucalyptus macrorhyncha*
ER3	710974	6221161	820	822–852 on 18.iii.09	*Eucalyptus rossii* and *E. macrorhyncha*
ER4	701422	6220852	760	1305–1335 on 18.iii.09	*Eucalyptus viminalis*
WR1	703515	6222734	800	830–900 on 17.iii.09	*E. goniocalyx* and *Eucalyptus macrorhyncha*
WR2	703500	6222660	800	903–933 on 17.iii.09	*E. goniocalyx* and *Eucalyptus macrorhyncha*
WR3	703515	6222734	800	956–1026 on 17.iii.09	Not recorded
WR4	702450	6223960	800	1042–1112 on 17.iii.09	*E. macrorhyncha* and *Eucalyptus goniocalyx*
WR5	702530	6225290	820	1144–1214 on 17.iii.09	*Eucalyptus rossii* and *Callitris endlicheri*
WR6	702520	6226765	640	1315–1345 on 17.iii.09	*Callitris endlicheri* with *Acacia* shrublayer
WR7	703320	6224700	840	1450–1520 on 17.iii.09	*Eucalyptus rossii*, *E. macrorhyncha*
WR8	702620	6221820	840	920–950 on 19.iii.09	*Callitris endlicheri*

Figure 1. Location of the two blocks of Keverstone National Park.



phic rock with no large areas of rock outcrops. Surface rock is present but is generally as pieces less than 0.3 x 0.3 m located on clay soil. In areas of Keverstone West there are several areas of granite outcrops, which contain loose rock on rock. This is significant because many species of reptile are saxicolous.

Vegetation communities

The native vegetation in the reserve is primarily woodland. However there is a small area of Ribbon Gum *Eucalyptus viminalis* tall open forest at a gully site where the soil has a greater moisture content and depth (site EG4). The main canopy species are Scribbly Gum *Eucalyptus rossii*, Bundy *E. goniocalyx* and Red Box *E. polyanthemos* on the ridges and slopes. Stands of Tea-tree *Leptospermum* spp. and Cypress Pine *Callitris endlicheri* occur in select areas such as the granite outcrops in Keverstone West. The forests have been logged very selectively and old growth elements such as stags, hollow bearing trees and large fallen logs are common. There was no evidence of recent fire.

Reptile surveys

Diurnal reptile surveys were conducted at 17 sites between 16 and 19 March 2009. The census involved two people surveying 0.5 hectare (50 x 100 m) for 30 minutes. A total of 60 min search effort was achieved for each transect. Surveys were conducted between 0842 and 1528 hrs EST, at temperatures which ranged between 15–22° C. The methods follow those determined by the NSW National Parks and Wildlife Service for the purpose of the comprehensive regional assessment of forests in southern NSW.

Transects were generally separated by a minimum of one kilometre and located within 50–100 metres of dirt roads or fire trails. The altitude of the sites ranged from 640–880 m AHD. The location of survey sites is given in Table 1. Survey sites were either in a gully, ridge or midridge. The selection of a gully, ridge and midridge attempted to sample a variation in habitat based on moisture gradients. Previous surveys of reptiles on the south coast, slopes and ranges (Daly *et al.*, 2001; Daly, 2004, 2006, 2007) indicate a higher species diversity of reptiles occurs on ridge sites, especially those that contain loose rock exfoliations. On the basis of these data the majority of sites were located on ridges in an attempt to maximise the number of species detected.

During herpetofauna searches active animals were observed as they basked or foraged. Inactive animals were found by lifting loose rock, logs and decorticating bark and searching leaf litter. Animals were identified by sight and generally were not caught. Reptiles observed when travelling to and from sites or outside the survey period and those found during targeted surveys for non-standard time intervals were recorded as opportunistic sightings and were used to collate a species list for the reserve.

RESULTS

Plot data and opportunistic observations

A total of 147 individuals covering 14 species of reptile was observed during 17 hours of systematic survey (Table 2). An additional species, the Jacky Dragon *Amphibolurus muricatus* was detected opportunistically (Table 3). Three species of reptile accounted for about 60% of detections: the Garden Skink *Lampropholis guichenoti* (31%), Three-toed Skink *Hemiergis decresiensis* (17%) and Red-throated Skink *Acritoscincus platynotum* (13%). Some of the surveys were conducted at sub-optimal temperatures and this may have impacted on results.

Cunningham's Skink *Egernia cunninghami* (southern tablelands form), Boulenger's Skink *Morethia boulengeri* and the Inland Wall Skink *Cryptoblepharus australis* were only detected at one site (WR6). This site had the lowest altitude of the sites surveyed (640 m).

The species diversity ranged from 1–5 over the plots with an average of 3.2 species being found over the 17 sites. Keverstone West had, on average, a marginally higher species diversity than Keverstone East (3.5 vs 2.8).

Table 2. Reptiles detected at systematic and targeted sites.

Key: E = Keverstone East, W = Keverstone West, G = gully, M = midridge, R = ridge.

Species		Sites																	
		EG1	EG2	EG3	EG4	EM1	ER1	ER2	ER3	ER4	WR1	WR2	WR3	WR4	WR5	WR6	WR7	WR8	Tot
Christinus marmoratus	Marbled Gecko												2				1	1	4
Diplodactylus vittatus	Stone Gecko							3				1						1	5
Acritoscincus platynotum	Red-throated Skink	5					9	1			2	2							19
Cryptoblepharus australis	Inland Wall Skink															5			5
Ctenotus taeniolatus	Copper-tailed Skink										1	3	1	2		1		3	11
Egernia cunninghami	Cunningham's Skink															2			2
Egernia striolata	Tree Skink										1	1	1		1	2			6
Eulamprus quoyii	Eastern Water Skink	5	4																9
Hemiergis decresiensis	Three-toed Skink	5		1	3	9	2	1	2					1					24
Lampropholis delicata	Grass Skink		1		7									1					9
Lampropholis guichenoti	Garden Skink	1	1	13	4	11	6	1	1	1		1		6					46
Lerista bougainvillii	Bougainville's Skink												1	1	1				3
Morethia boulengeri	Boulenger's Skink															2			2
Pseudechis porphyriacus	Red-bellied Black Snake		1																1
Total Species		4	4	2	3	2	3	4	2	1	3	5	4	5	2	5	1	3	146

Table 3. Reptiles of Keverstone NP

O = observed during survey, P = previously recorded in area (Daly *et al.*, 2001; S. Power, pers. obs.), KE = Keverstone East, KW = Keverstone West.

Family	Species	Common Name	KE	KW
Gekkonidae	*Christinus marmoratus*	Marbled Gecko	O	O
	Diplodactylus vittatus	Eastern Stone Gecko	O	O
Varanidae	*Varanus varius*	Lace Monitor		P
Agamidae	*Amphibolurus muricatus*	Jacky Dragon	O	
	Amphibolurus nobbi	Nobbi Dragon		P
	Pogona barbata	Bearded Dragon		P
Scincidae	*Acritoscincus platynotum*	Red-throated Skink	O	O
	Cryptoblepharus australis	Inland Wall Skink		O
	Ctenotus taeniolatus	Copper-tailed Skink	O	O
	Egernia cunninghami	Cunningham's Skink		O
	Egernia striolata	Tree Skink	O	O
	Eulamprus quoyii	Eastern Water Skink	O	
	Hemiergis decresiensis	Three-toed Skink	O	O
	Lampropholis delicata	Grass Skink	O	O
	Lampropholis guichenoti	Garden Skink	O	O
	Lerista bougainvillii	Bougainville's Skink	O	O
	Morethia boulengeri	Boulenger's Skink		O
	Trachydosaurus rugosus	Shingleback		P
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	O	

DISCUSSION

Species diversity and density

The present study recorded a total of 15 (14 during systematic surveys) species of reptiles. Previous surveys in Keverstone West recorded the Nobbi Dragon *Amphibolurus nobbi* and Shingleback *Trachydosaurus rugosus* (Daly *et al.*, 2001), and opportunistic sightings of *V. varius* and *P. barbata* made by one of us at other times provide a total of 19 species for the Park. Small elapids and members of the family Typhlopidae and Pygopodidae were not detected.

Reptile diversity was highest in areas with exposed rock outcrops, which occurred only in Keverstone West. This trend is similar to that reported previously for the region (Daly *et al.*, 2001; Daly, 2004, 2006, 2007). Two species, *M. boulengeri* and *C. australis*, were only detected at site WR6, the lowest elevation site surveyed (640 m), and with extensive areas of exposed rock on granite outcrops.

The presence of *Cryptoblepharus australis* represented an extension to the recorded range (Atlas of Living Australia) of this species. Previous surveys in the area detected *Cryptoblepharus pulcher* (previously known as *virgatus*) at Abercrombie Caves, some 20 km to the north-east but no evidence of sympatry was recorded during our study.

Conservation strategy

The two portions of the Park are separated by less than two kilometres and Keverstone East is less than one kilometre from Razorback NP. There is a need to consolidate these currently fragmented portions to form a contiguous block of land within the reservation system to facilitate the movement of wildlife. The land between the reserves has been largely cleared but given time will regenerate and link the currently isolated forest patches. Some species of reptile can disperse over fragmented landscapes but for the conservation of biodiversity there is a need to provide secure tenure.

The surrounding landscape has been largely cleared of native vegetation and these reserves support the largest block of bush for many kilometres. For this reason we also propose that additional land be added to the reserves. In particular, relatively intact forest to the south of Keverstone East would make a suitable addition to the reserve.

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NOTES ON THE NORTHERN MANGROVE SEASNAKE *PARAHYDROPHIS MERTONI* (ROUX, 1910) (SERPENTES: ELAPIDAE)

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INTRODUCTION

Parahydrophis is a monotypic genus of hydrophiine elapid snake that displays a series of morphological attributes that have been interpreted as 'primitive' among sea snakes, including a nearly cylindrical head and body and retention of broad ventral scales, as seen in terrestrial proteroglyphs (Greer, 1997).

The Northern Mangrove Seasnake, *Parahydrophis mertoni*, is known to occur in coastal waters of the Arafura Basin including the Aru Islands, the lower Gulf of Carpentaria and the coast of Arnhem Land (Cogger, 2000). Sweet (1989) compared the biology of *Parahydrophis* with two similar 'primitive' monotypic sea snake genera; *Hydrelaps* and *Ephalophis*, commenting that *Hydrelaps* will forage terrestrially on fully-exposed marl flats while *Parahydrophis* and *Ephalophis* appear to forage in mangroves along tidal creek banks rather than exposed marl flats. Gow (1989) remarked the species feeds upon small fish and reported a gravid female carrying three large embryos. At the time of writing, *Parahydrophis mertoni* is listed as a species of 'least concern' in Schedule 1: Conservation Status of Animals of the Northern Territory (Department of Natural Resources, Environment, the Arts and Sport, 2007).

Very little is known about the biology of this species (Greer, 1997), and this note documents the capture of a recent specimen with additional observations gathered from the dissection of preserved specimens held at the Museum and Art Gallery of the Northern Territory (MAGNT) and Australian Museum (AM). The sex of specimens was determined by observation of internal reproductive organs or, in the case of one late embryo examined, the presence of everted hemipenes. Maturity was determined by the presence of enlarged testes and opaque, convoluted efferent ducts in males and by the presence of oviducal follicles or embryos in females (Shine, 1991b).

OBSERVATIONS

At 2021 hrs on 10 February 2011, while conducting an ecological study on homalopsid snakes at Wickham Point in Darwin Harbour, a mature male *P. mertoni* was observed by the authors in ~40 cm of water on an incoming tide (12°33'18.6"S 130°54'41.34"E).

The snake appeared to be foraging on the bottom of the submerged mudflat which is typically exposed at low tide. When captured and placed on dry land, the snake proved to be particularly mobile and even attempted to seek refuge in nearby crab burrows on a number of occasions. It demonstrated a remarkable willingness to bite when handled. Realising the uniqueness of this find, the snake was collected and deposited at MAGNT (NTM R36475). It is the first specimen of this species accessioned into the MAGNT collection since 1987.

Examination of our recently collected specimen and the preserved specimens from MAGNT and AM has shown that mature *P. mertoni* do not appear to display any obvious sexual dimorphism between the sexes for either snout-vent length (SVL) or tail length (TL) (Table 1). None of the specimens displayed any development of rugose body scales, which is contrary to the norm seen in other hydrophiid snakes (Avolio *et al.*, 2006). One female was found to contain three fully-developed embryos in the early dry season (May). This is presumably the specimen noted

Table 1. *Parahydrophis mertoni* specimens examined.

Museum Registration Number	Sex	Location	Collection Date	SVL	TL	Reproductive status
NTM R459	F	Mouth of Roper River, Gulf of Carpentaria	June 1974	425	54	Mature; 2.5mm testes, opaque efferent ducts
NTM R8677	M	Dinah Beach, Darwin Harbour	13 May 1979	485	63	Mature; 3 near full-term young (1 of which is registered as NTM R8678)
NTM R8678	F	Dissected offspring of R8677		156	25	Immature
NTM R8679	M	Elizabeth River, Darwin Harbour	June 1980	399	44	Mature; 3 ova in left oviduct (2.45mm width)
NTM R13607	?	Palmerston Boat Ramp, Darwin Harbour	9 October 1987	186	24	Immature
NTM R36475	F	Wickham Point, Darwin Harbour	10 February 2011	505	65	Mature; 4.77 mm testes, opaque efferent ducts.
AM R54955	M	Ck connecting Woolen River to Hutchinson Straight	19 September 1975	415	50	Mature; 3 oviducal egg masses.
AM R54956	F	Bend 3 Liverpool River	January 1975	421	55	Mature
AM R123416	F	Rapid Ck, NT	1987	466	62	

and pictured by Gow (1989). Another two females had a litter size of three, with undeveloped unshelled oviductal eggs (largest 2.45 mm diameter) in the early and late dry season (June and September). One of these specimens (AM R54955) is presumably the specimen referred to by Greer (1997). Additionally, one juvenile was collected in the late dry season (October) and measured only 29 mm longer than one of the dissected full-term embryos. Two males examined appeared to be fully mature, evident by opaque and convoluted efferent ducts, in the mid wet season (February) and early dry season (June).

No prey items were detected in the stomachs of any examined specimens.

DISCUSSION

The lack of published information on *Parahydrophis mertoni* probably reflects the difficulty in encountering this species. The authors have spent much time studying the ophidian fauna of mangrove estuaries in Darwin Harbour over the past twelve months and only one *Parahydrophis* has been found in that time (NTM R36475). The relatively low number of *Parahydophis* specimens (6) held at MAGNT compared to other sympatric species such as *Hydrelaps* (17), *Fordonia leucobalia* (196) and *Myron richardsonii* (32) also provides evidence that *Parahydrophis* is uncommonly encountered. In addition to the specimens currently held at the MAGNT, the authors are aware of two other records of *Parahydrophis* from Darwin Harbour in the past 24 years. One was collected by Dr Michael Guinea in 1987, swimming in less than a metre of water in the late afternoon in Rapid Creek, NT. A photograph of this particular snake, now in the AM collection, can be seen in Cogger (2000), Wilson and Swan (2003 and subsequent editions) and Shine (1991a). A second *Parahydrophis* was caught in a mangrove estuary bordering Charles Darwin National Park on 29 September 1999, by Charles Darwin University student Julie Martin while surveying for fish. The snake became entangled in a trammel net, presumably during the night.

Our findings in relation to body sizes are comparable to the very limited data presented elsewhere (Gow, 1989; Cogger, 2000; Greer, 1997) which is not surprising considering many of the same snakes were examined. Based on our results, it appears that *Parahydrophis* reaches a maximum total length of 570 mm, with mature animals averaging 501 mm. Unfortunately no information is available on the reproduction of primitive relatives of *Parahydrophis* such as *Hydrelaps* or *Ephalophis* for comparison with our observations. The female with advanced embryos was collected in the early dry season, while the two females with undeveloped oviducal egg clutches were collected in the early and late dry season. The presence of a gravid female in the early stages of pregnancy one month after the collection of one with full-term embryos suggests a moderately extended

Figure 1. *Parahydrophis mertoni* collected at Wickham Point, NT (photo: T. Parkin).

reproductive season but without additional specimen material, it is impossible to conclude whether reproduction follows a seasonal pattern or occurs year-round. Most sea snakes for which there are adequate data show some seasonality in female reproduction (Greer, 1997), and it could be assumed that *Parahydrophis* is similar in this respect. Male *Parahydrophis* produce sperm at least in the late wet season and early dry season but without further specimen material it is difficult to establish if sperm are retained in in the vas deferens year round as seen in the terrestrial elapid species; *Pseudonaja textilis* (Shine, 1977).

Whether the species is in fact uncommon or simply elusive remains to be seen. Because of the paucity of encounters with this species, we propose the conservation status of *Parahydrophis* in the Northern Territory be changed from 'Least Concern' to 'Data Deficient' in recognition of the lack of evidence available to make an assessment on its risk of extinction. The authors believe that changing the listing to 'Data Deficient' will acknowledge that future research is required and might indeed show that a 'Threatened' status for *Parahydrophis mertoni* in the Northern Territory is appropriate.

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OBSERVATIONS OF TREE FROGS SHELTERING IN A HOT MAILBOX

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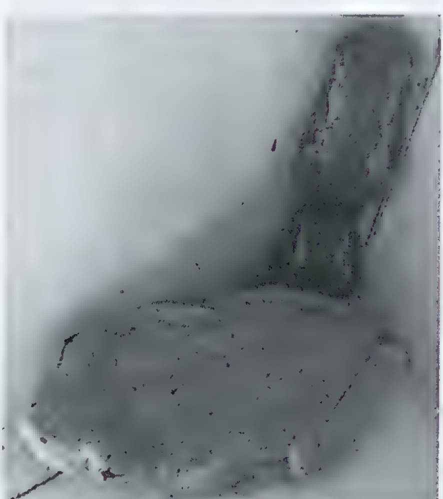
INTRODUCTION

Many terrestrial amphibian species are nocturnal and use diurnal shelters to avoid unfavourable environmental conditions and predators (Denton & Beebee, 1993; Spieler & Linsenmair, 1998; Malmgren *et al.*, 2007; Roznik & Johnson, 2009). Taking refuge during daylight hours enables animals to reduce dehydration rates and maintain lower body temperatures when conditions outside are inhospitable (Schwarzkopf & Alford, 1996; Seebacher & Alford, 2002). Desiccation risks can be particularly high and natural shelter scarce in habitats altered by anthropogenic land use (Rothermel & Luhring, 2005; Rittenhouse *et al.*, 2008).

The following observations were made opportunistically on a rural residential property near Wauchope in *Biripi* Aboriginal Country in the New South Wales (NSW) north coast bioregion. The two species concerned are common on the NSW north coast and are pond-breeding arboreal hylids (Barker *et al.*, 1995).

Figure 1. *Litoria peronii* and *Litoria dentata* sheltering in mailbox (Photo: Cathy Norris).



OBSERVATIONS

One Peron's Tree Frog (*Litoria peronii*) and two Bleating Tree Frogs (*Litoria dentata*) were found sheltering by day inside a standard metal mailbox (260 mm long x 160 mm wide x 140 mm high and about 1 m above the ground) on 2 February 2011 (Figure 1). The frogs were positioned in corners of the mailbox in a water-conserving posture with all limbs held close against the body and the ventral surface pressed against the substrate, thereby reducing the exposed surface area. Weather conditions had been hot and dry for several days. The mailbox was partly shaded by eucalypt trees during the early morning but was exposed to full sunshine over the afternoon. At 1430 hrs Eastern Summer Time on 2 February 2011 the temperature inside the mailbox was 39°C (measured with a mercury thermometer), several degrees hotter than the outside temperature.

Both frog species had been frequently observed using the mailbox as a diurnal refuge site on previous occasions over several years, the number of individuals present varying from day to day, and no dead frogs (such as any that had succumbed to overheating) were found there over this period (B. Murphy, pers. comm.). Regular observations over February 2011 indicated that the number of frogs present varied between zero and six, with lower numbers tending to coincide with wet weather, and that the daytime temperature difference between the interior of the mailbox and outside was up to 7°C (B. Murphy, pers. comm.).

DISCUSSION

The hot interior of a metal mailbox exposed to solar radiation does not seem to be an ideal diurnal retreat site for frogs. While the site described would provide good security from diurnal predators such as birds and snakes it would appear disadvantageous in avoiding adverse environmental conditions. The elevated temperatures of this diurnal retreat site are apparently still within the limits tolerable to these species, as animals have used the site on a regular basis over an extended period. Arboreal frogs including Australian hylids have been found to have a higher resistance to evaporative water loss than ground-dwelling, aquatic or semi-aquatic species (Wells, 2007). Nevertheless, it is interesting that frogs would choose to shelter in a site with a higher than ambient temperature during hot, dry summer conditions. It is possible that security from predators is a more important shelter attribute than microclimate for these two species.

When shelter sites are in short supply they may be used continually by the same individuals or simultaneously used by more than one animal (Spieler & Linsenmair, 1998), and the regular use of this site may possibly reflect a scarcity of more suitable sites in the immediate area. These observations also illustrate the behavioural adaptability of these two frog species in making use of non-natural shelter sites in habitats altered by anthropogenic land use.

ACKNOWLEDGMENTS

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PREDATION OF A MITCHELL'S WATER MONITOR (*VARANUS MITCHELLI*) BY A YELLOW SPOTTED MONITOR (*VARANUS PANOPTES*)

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INTRODUCTION

Observations of predators and their interactions with prey species provides important opportunities for understanding their role in ecosystem function and prey regulation. The Yellow-spotted Monitor (*Varanus panoptes*) is a large lizard inhabiting riparian habitats, coastal areas and woodland across Northern Australia (Cogger, 2000). The diet of *V. panoptes* is typical of a generalist predator (James *et al.*, 1992), consuming virtually any animal material including carrion, eggs, invertebrates and vertebrates (Christian, 2004; Shine, 1986). Dietary studies of *V. panoptes* have confirmed that at times, V. *panoptes* will capture and consume monitors (Christian, 1995; Shine, 1986).

In nature, predators can influence the behaviour and/or survival of prey species in areas which experience high levels of predation. For example, *V. panoptes* limited levels of recruitment in prey species in the Northern Territory (Doody *et al.*, 2006, 2009). Given the large number of other species recorded in the diet of *V. panoptes*, there is potential that a range of prey species could be regulated by *V. panoptes*.

Here we present the first documented predation of a Mitchell's Water Monitor (*Varanus mitchelli*) by *V. panoptes*. This observation builds on previous dietary studies and contributes to our understanding of the foraging behaviour of *V. panoptes*.

Figure 1. A Yellow-spotted Monitor (*Varanus panoptes*) preys upon a Mitchell's Water Monitor (*Varanus mitchelli*). Photograph by David Rhind.

FIELD SITE

Our observation occurred along the Pentecost River at El Questro Wilderness Park in the east Kimberley Region, Western Australia. The Pentecost River is located in the wet-dry tropics and is subject to highly seasonal flows. Riparian vegetation at the observation site, dominated by *Melaleuca* sp. and *Pandanus aquaticus*, borders an established campground which is a disturbed area of open grass bordering on tropical savannah.

OBSERVATIONS

At ~1000 hrs on the morning of 26 May 2010, a large *V. panoptes* (~ 1.5 m in length) was observed basking in grass approximately 5 m from the Pentecost River. Approximately 20 minutes later the *V. panoptes* ran quickly down the river bank towards a patch of Pandanus and out of sight. After a brief search the goanna was found under a Pandanus bush with a live, medium-sized Mitchell's Water Monitor (*Varanus mitchelli*) in its mouth (Figure 1). The *V. panoptes* had grasped the *V. mitchelli* around the back legs and tail (Figure 1). After about 3 minutes the *V. panoptes* moved rapidly through a patch of Pandanus, along the river bank for approximately 30 metres and out of sight. After this point, no further observations were able to be made.

DISCUSSION

Our observation confirms that *V. panoptes* is a predator of *V. mitchelli*, and further contributes to our understanding of both the diet and behaviour of *V. panoptes*. Varanid lizards were suggested by Shine (1986) to be important prey items of *V. panoptes*, in terms of biomass, although they were few in number in his study. Previous observations of *V. panoptes* have confirmed that the species will actively prey on *Varanus gouldii* (Christian *et al.*, 1995) and smaller individuals of *V. panoptes* (Doody, *pers. obs.*). There is potential that *V. panoptes* is exerting considerable predation pressure on *V. mitchelli* in areas where the species co-occur The recent decline and disappearance of *V. panoptes* from many areas across northern Australia due to lethal toxic ingestion by invasive cane toads has already altered the dynamics of at least 1-2 prey species (Doody *et al.*, 2006, 2009). When cane toads first arrived at the Daly River, *V. panoptes* declined sharply while *V. mitchelli* increased for a year; *V. mitchelli* subsequently declined rapidly as smaller toads became available as food items (Doody *et al.*, 2009). Our observation confirms a hitherto unreported trophic link that supports *V. mitchelli* as prey of *V. panoptes*. Further studies would help to identify whether predation by *V. panoptes* on *V. mitchelli* is significant enough to regulate recruitment and/or the behaviour of *V. mitchelli* and other sympatric species of monitors in northern Australia.

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AN OBSERVATION OF MALE COMBAT IN THE CARPET PYTHON (*MORELIA SPILOTA*) FROM MELVILLE ISLAND, NORTHERN TERRITORY

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INTRODUCTION

Observations of intraspecific interactions between animals provide important insights into the mating system of a particular species. The males of many animal species including reptiles often engage in male combat. Male combat typically involves two males 'fighting', presumably to gain access to a nearby female (Shine, 1994, Shine & Fitzgerald, 1995).

The Australian carpet python (*Morelia spilota*) occurs over extensive areas of mainland Australia (Cogger, 2000). This species has a mating system which includes both mating aggregations and male combat (Shine & Fitzgerald, 1995). Shine and Fitzgerald (1995) suggested that populations in northern Australia (Queensland and northern New South Wales (NSW)) typically engage in male combat, while populations from southern NSW form mating aggregations. The authors also proposed that this variation in mating behaviour influenced the evolution of sexual size dimorphism: species or populations exhibiting male combat will exhibit larger relative body size in males (Madsen *et al.*, 1993; Shine, 1994; Lloyd & Fearn, 2005; but see Doody *et al.*, 2010). Larger males are likely

Figure 1. Carpet pythons (*Morelia spilota*) engaged in male combat on Melville Island, NT. Photograph by David Rhind.

to be more successful in combat and gain better access to reproductive females.

In this paper, we present the first published record of male combat in the carpet python (*Morelia spilota*) from the Northern Territory. We discuss the relevance of this observation to male combat and sexual size dimorphism in carpet pythons in general.

OBSERVATIONS

At ~1100 hrs on 26 June 2008, a pair of adult carpet pythons were observed intertwined together on an unsealed road on Melville Island, Northern Territory (Figure 1). The road was located on the top of a small ridge immediately adjacent to an area of open woodland. Both snakes were entwined with raised heads and were observed repeatedly trying to force the head of the other down (Figure 1). The pair were observed for several minutes from a stationary vehicle prior to leaving the site. Although not closely examined, the snakes' behaviour indicated that they were males (the behavior accorded with male combat observed by others; no females have been observed in this stereotypical behavior). No sign of biting or injuries were observed on either animal. Both snakes were approximately 1.7 m in total length.

DISCUSSION

Our observation is the first published record of male combat from Melville Island, and the Northern Territory. Pearson *et al.* (2002) indicate male combat in NT populations of *M. spilota* (see their Figure 1), but give no data to support it. However, slash marks on individuals from Fogg Dam, NT are consistent with male combat scars (R. Shine, pers. comm.). Regardless, our observation is consistent with the suggestion that male-male combat is restricted to northern taxa of carpet pythons (Shine & Fitzgerald, 1995).

Shine and Fitzgerald (1995) also suggest that populations of carpet pythons that engage in combat typically exhibit male-biased sexual size dimorphism. Unfortunately, insufficient numbers of specimens from Melville Island are available to confirm male-biased size dimorphism in that population. However, males are generally larger than females in the Northern Territory populations (D. Trembath, unpubl. data). Further observations of male combat in NT *M. spilota*, and in particular a quantitative analysis of sexual size dimorphism in Melville Island *M. spilota*, would further clarify the relationship between male combat and sexual size dimorphism in this species.

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PETER RANKIN TRUST FUND FOR HERPETOLOGY

For a period of just over 30 years (the first grants were awarded in 1981 – see Herpetofauna 13(1): 35) the Peter Rankin Trust Fund for Herpetology has been awarding small grants to young herpetologists to support their research. The fund has over that period of time been administered by the staff of the Herpetology section of the Australian Museum with the assistance of a number of committee members, among which there has always been a member of the Rankin family.

However, with a combination of aging demographics within the committee and administrative and philosophical changes within the Australian Museum it was evident the Fund was unlikely to be able to continue in its present form. To ensure continuity of the Fund in a form compatible with its objectives the decision was made to incorporate it into the Australian Museum's round of annual grants for postgraduate students. In this form the Fund is still specifically for the study of herpetology and still caters for its largest audience (the vast majority of applications in recent years have been from research students rather than amateur herpetologists not associated with universities), but is now primarily geared to studies that include the use of the Australian Museum herpetology collection. As such it is still very much in the spirit of the individual whose premature passing led to its inception.

Applications for funding will be open from July each year, closing mid May the following year. Applications will be considered in either of the following categories:

- honours student
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The information and application form for each year's call for funds is accessible via the Australian Museum's website:

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The application form is only available in PDF format.

The application should be brief and concise but with enough detail to allow the proposal to be evaluated. Additional pages may be used if absolutely necessary.

Individual grants will range to a maximum of $1,000.

NOTES TO CONTRIBUTORS

Herpetofauna publishes articles on any aspect of reptiles and amphibians. Articles are invited from interested authors particularly non-professional herpetologists and keepers. Priority is given to articles reporting field work, observations in the field and captive husbandry and breeding.

All material must be original and must not have been published elsewhere.

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Authors are responsible for the accuracy of the information presented in any submitted article. Current taxonomic combinations should be used unless the article is itself of a taxonomic nature proposing new combinations or describing new species.

Original illustrations will be returned to the author, if requested, after publication.

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Two copies of the article (including any illustrations) should be submitted. Typewrite or handwrite (neatly) your manuscript in double spacing with a 25mm free margin all round on A4 size paper. Number the pages. Number the illustrations as Figure 1 etc., Table 1 etc., or Map 1 etc., and include a caption with each one. Either underline or italicise scientific names. Use each scientific name in full the first time, (eg *Delma australis*), subsequently it can be shortened (*D. australis*). Include a common name for each species.

The metric system should be used for measurements.

Place the authors name and address under the title.

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The senior author will receive a PDF copy of their article.

Green Iguana (*Iguana iguana*) from Townsville, Queensland (Photo: E. Roznik). See paper on this introduction record on p. 25.

Whip Snake (*Demansia quaesitor*) from near Adelaide River, Northern Territory (Photo: C. Jolly). See paper on this species on p. 28.